

## **MEMORANDUM**

**TO:** Jennifer Hanson

**FROM:** Jared Emery | Jeff Meyer

**DATE:** January 9, 2024

**RE: Bay Delta Phase II Report Effects on NID System**

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As requested, Western Hydrologics has completed a series of studies simulating the proposed Sacramento / Delta Update to the Bay-Delta Plan (proposed plan). The purpose of this effort is to evaluate NID water supply impacts from the proposed plan. The proposed plan amendments include year-round flows of 55% of unimpaired inflows with an adaptive range from 45% – 65% that would apply to salmon bearing tributaries of the Sacramento River and Delta. The plan also includes a cold-water habitat objective and implementation measures.

The State Water Resources Control Board modeled the proposed plan amendments with the Sacramento Water Allocation Model (SacWAM). The assumptions used in SacWAM include year-round bypass flows of 55% of the unimpaired flows for the salmon bearing tributaries. The compliance points for these instream flow requirements are at the mouths of each major tributary to the Sacramento River and the Delta. The assumptions also include all baseline scenario assumptions. Baseline scenario assumptions include existing reservoir operations and stream flow requirements, including current regulatory requirements and historic hydrology. The Staff Report lists all the locations of the proposed SWRCB Instream Flow Requirements in SacWAM. For NID, locations of interest are:

- Bear River above confluence with Feather River
- Middle Yuba River above confluence with North Yuba River
- South Yuba River above Englebright Reservoir
- Yuba River above confluence with Feather River
- Feather River above confluence with Sacramento River

In addition to the Instream Flow Requirements, the proposed changes to the Bay-Delta Plan include end of September carryover storage targets at rim reservoirs to maintain cold water pool targets. These storage targets do not include any NID Reservoirs but do include Camp Far West and New Bullards Bar.

### **Key ResSim Modeling Assumptions**

Key modeling assumptions focused almost entirely on setting the instream flow requirements. Minimum flow requirements in the modeling studies are the greater of 55% of unimpaired flow or the existing FERC license requirements. A model rule was placed at each reservoir in the model, setting a minimum release to the river of the maximum of the current FERC License requirement or 55% of the unimpaired flow at that location. Low level outlet capacities were increased as needed to allow the reservoirs to be able to pass 55% of unimpaired flow.

At Drum Afterbay and Dutch Flat Afterbay, rules were not added to keep 55% of unimpaired flow in the river, and the unimpaired flow was permitted to flow through the powerhouse penstocks and return to the rivers to preserve generation while still moving the water downstream. Below each point of diversion the existing FERC License requirements were used so that flows were maintained in the bypass reaches. Flows in excess of the powerhouse capacities remained in the river channels.

The drought contingency plan was also removed allowing the model to use all available storage to meet demands as much as feasible.

## Studies Performed

The following studies were performed and analyzed:

*Table 1 - Scenarios Modeled*

Number	Name	Demand	Hydrology	MinFlows
1	Existing Conditions	Current Historical	Historical	Existing FERC min flows
2	PFW Scenario 4-55%	Median Projected	Dry Climate Change	55% of unimpaired flow or Existing FERC min flows
3	PFW Scenario 5-55%	Median Projected	Median Climate Change	55% of unimpaired flow or Existing FERC min flows
4	PFW Scenario 6-55%	Median Projected	Wet Climate Change	55% of unimpaired flow or Existing FERC min flows

## Diversions

Annual Average Diversions at several NID facilities are shown in Tables 2 through 6 and shown graphically in Figures 1 through 5.

*Table 2 - NID Diversions into Milton-Bowman Conduit*

	Historic Hydrology Existing FERC	Dry Climate 55% Unimpaired	Median Climate 55% Unimpaired	Wet Climate 55% Unimpaired
Extreme Critical	15,100	12,500	12,200	12,900
Critical Dry	34,700	13,000	20,200	22,200
Dry	47,100	21,900	24,300	24,700
Below Normal	65,700	30,300	30,000	34,300
Above Normal	84,100	29,700	36,900	37,500
Wet	68,400	39,300	42,200	40,400
All Years	60,700	25,100	30,400	33,200

*Figure 1 - NID Diversions into Milton-Bowman Conduit*

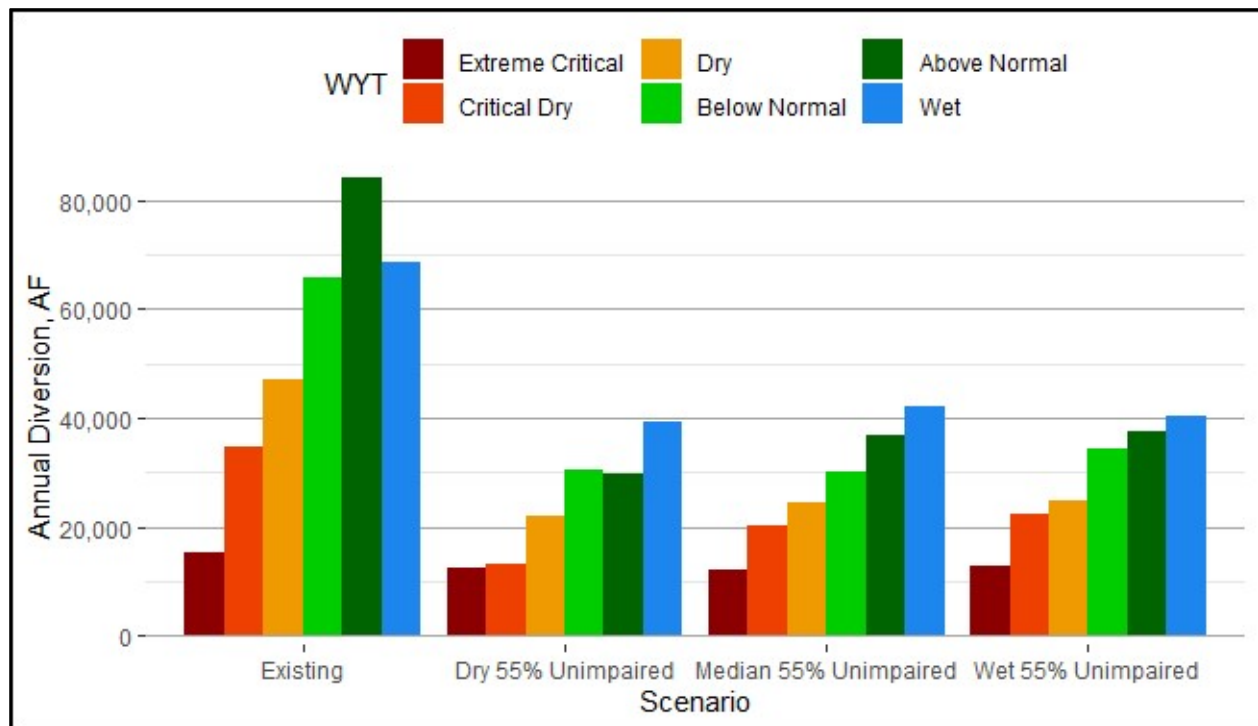


Table 3 - NID Diversions into Bowman-Spaulling Conduit

	Historic Hydrology Existing FERC	Dry Climate 55% Unimpaired	Median Climate 55% Unimpaired	Wet Climate 55% Unimpaired
Extreme Critical	50,000	40,400	46,400	46,300
Critical Dry	98,800	41,700	66,500	70,500
Dry	115,300	60,500	67,300	67,000
Below Normal	128,400	73,000	79,100	83,100
Above Normal	130,500	75,500	87,800	88,400
Wet	144,100	100,900	103,300	96,700
All Years	123,900	65,900	78,900	82,700

Figure 2 - NID Diversions into Bowman-Spaulling Conduit

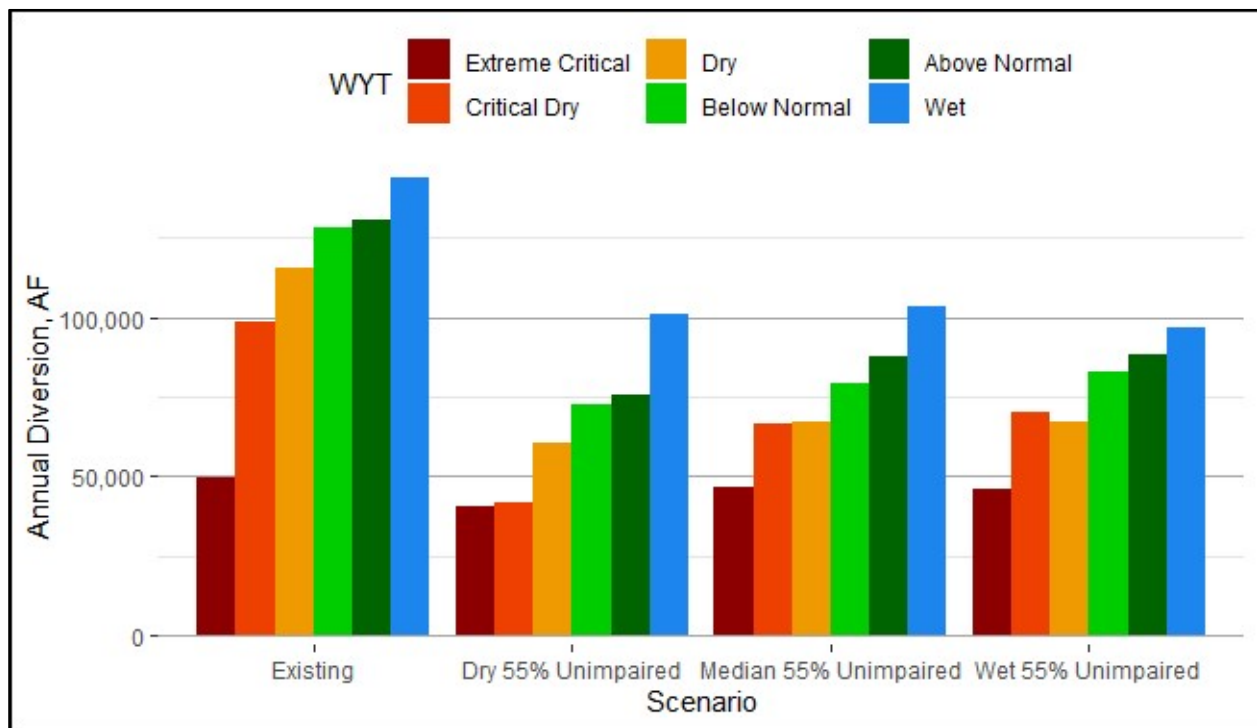


Table 4 - NID Diversions into Bear River Canal

	Historic Hydrology Existing FERC	Dry Climate 55% Unimpaired	Median Climate 55% Unimpaired	Wet Climate 55% Unimpaired
Extreme Critical	26,500	17,500	23,300	14,200
Critical Dry	32,400	22,500	29,800	22,700
Dry	38,900	29,000	29,400	23,200
Below Normal	40,200	31,800	35,500	33,800
Above Normal	39,800	32,300	38,400	39,000
Wet	40,200	39,500	38,600	40,300
All Years	38,500	29,600	34,000	33,200

Figure 3 - NID Diversions into Bear River Canal

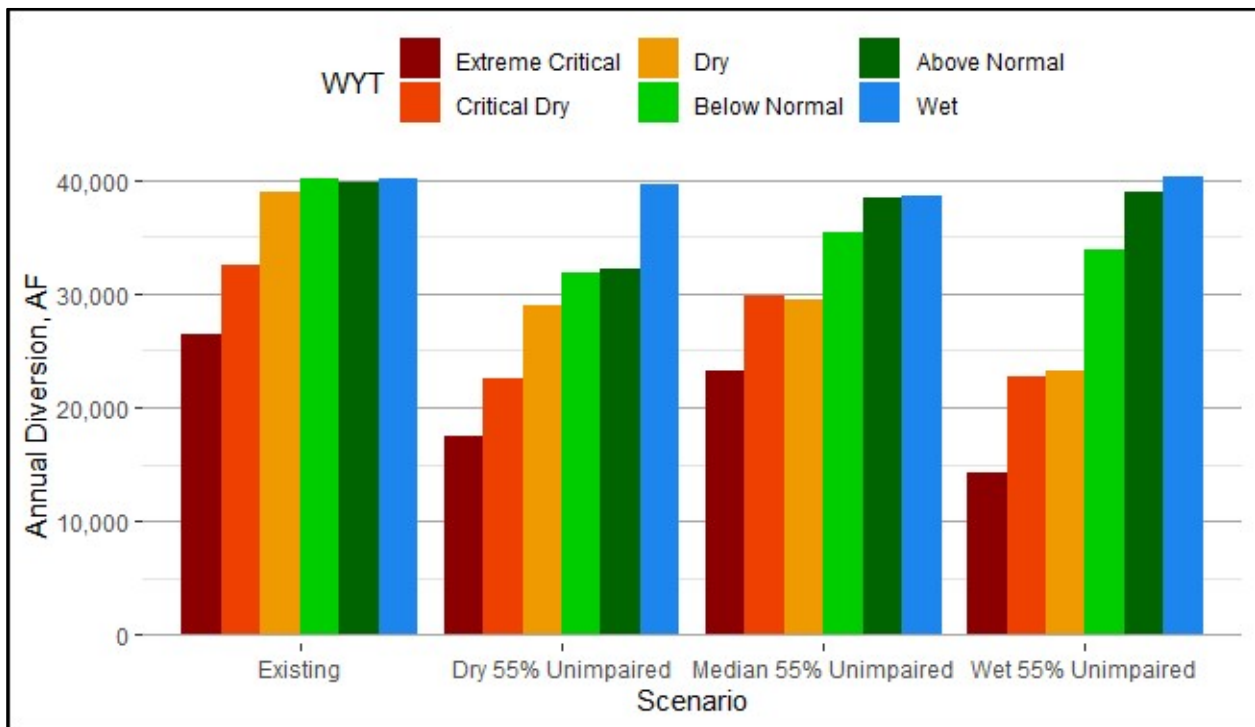


Table 5 - NID Diversions into Chalk Bluff Canal

	Historic Hydrology Existing FERC	Dry Climate 55% Unimpaired	Median Climate 55% Unimpaired	Wet Climate 55% Unimpaired
Extreme Critical	18,600	19,100	21,800	21,400
Critical Dry	26,200	20,200	27,800	28,400
Dry	30,100	25,900	28,100	28,500
Below Normal	33,800	29,900	31,800	31,500
Above Normal	33,000	30,600	33,800	32,500
Wet	39,000	36,200	37,700	34,700
All Years	32,700	27,400	31,300	31,400

Figure 4 - NID Diversions into Chalk Bluff Canal

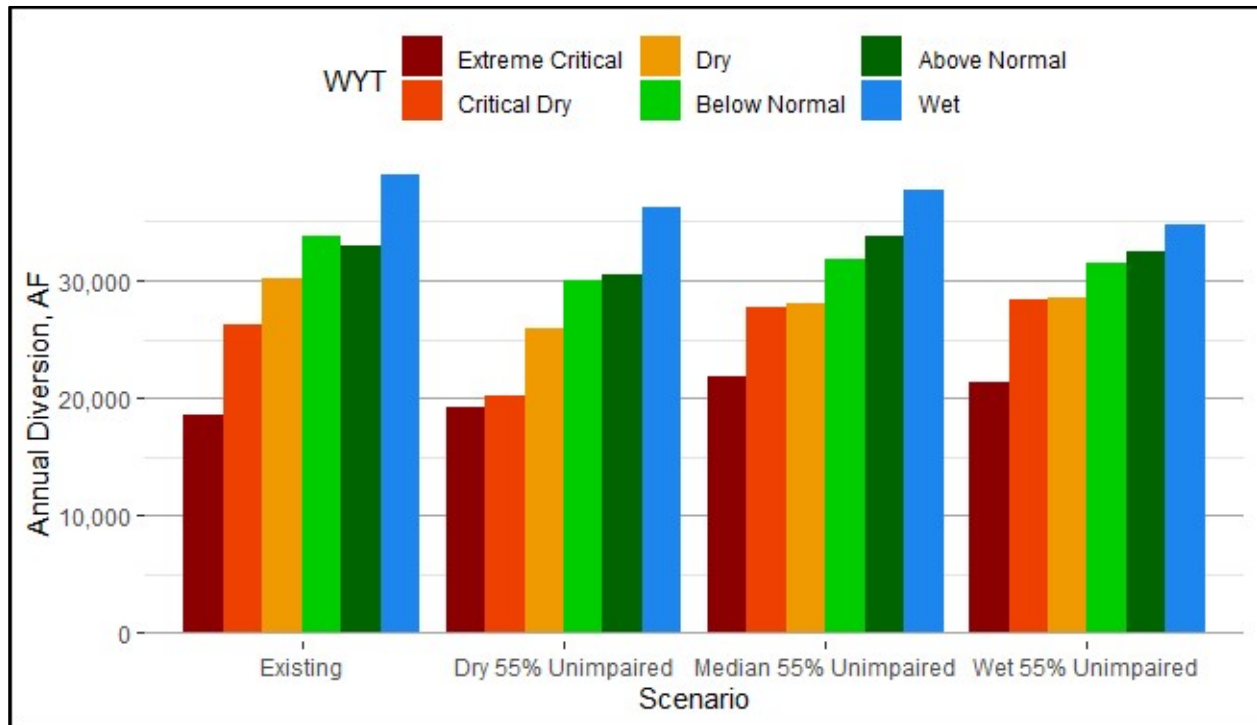
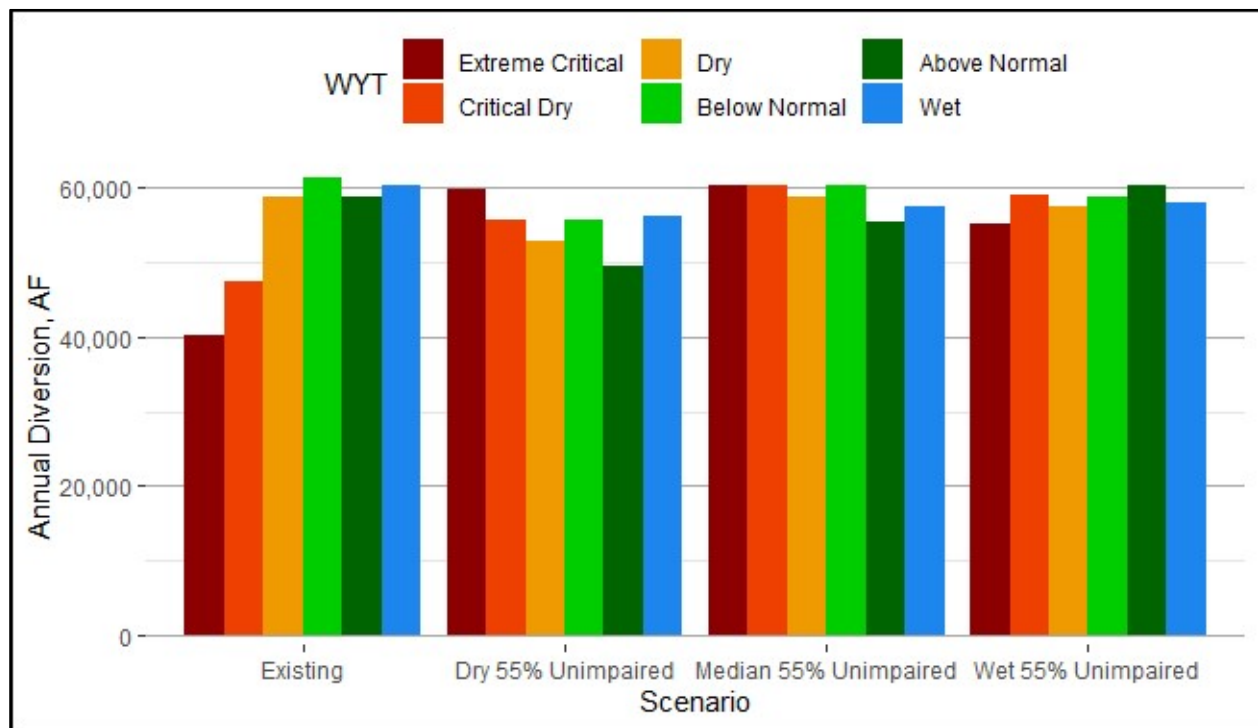


Table 6 - NID Diversions out of Lake Combie

	Historic Hydrology Existing FERC	Dry Climate 55% Unimpaired	Median Climate 55% Unimpaired	Wet Climate 55% Unimpaired
Extreme Critical	40,200	59,800	65,400	55,100
Critical Dry	47,400	55,500	65,700	59,000
Dry	58,800	52,800	58,600	57,400
Below Normal	61,300	55,700	60,600	58,700
Above Normal	58,600	49,500	55,300	66,100
Wet	60,200	56,100	57,500	57,800
All Years	57,700	54,600	58,700	59,600

Figure 5 - NID Diversions out of Lake Combie



## River Flows

Annual average flow in the River below NID Facilities are shown in Table 7. Average daily flow in a few selected reaches for the Median Climate Change Hydrology scenarios are shown in Figures 6 through 9.

*Table 7 - Average Annual Flows, AF*

Scenario	Middle Yuba at Milton	Canyon Creek at Bowman	South Yuba at Spaulding	Bear River at Combie	Deer Creek below Tunnel Canal	Texas-Fall Creeks
Existing Conditions	24,200	45,600	110,500	217,800	67,300	21,500
Dry 55% Unimpaired	40,200	38,200	127,900	101,700	16,700	24,000
Median 55% Unimpaired	46,500	45,500	156,700	155,100	25,100	28,000
Wet 55% Unimpaired	54,800	47,400	180,300	186,200	32,400	29,300

Figure 6 - Daily Average Flow in Middle Yuba below Milton

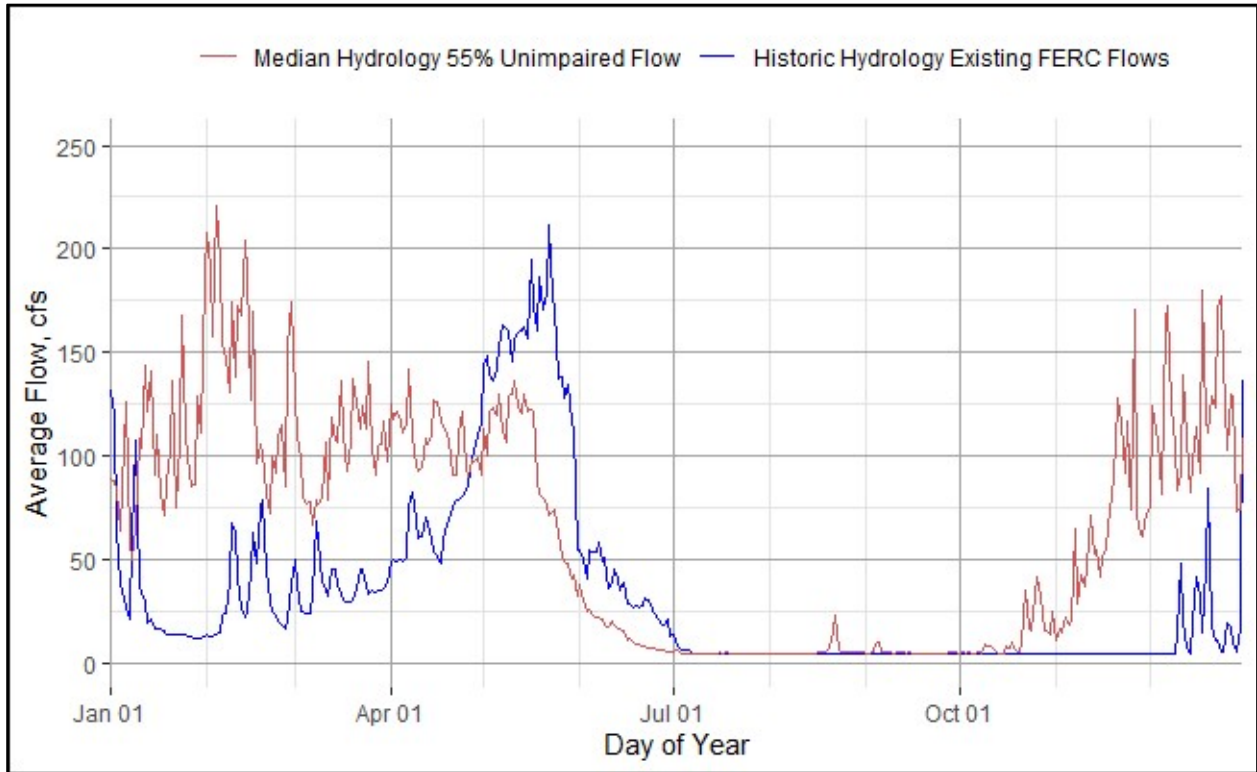


Figure 7 - Daily Average Flow in Canyon Creek below Bowman

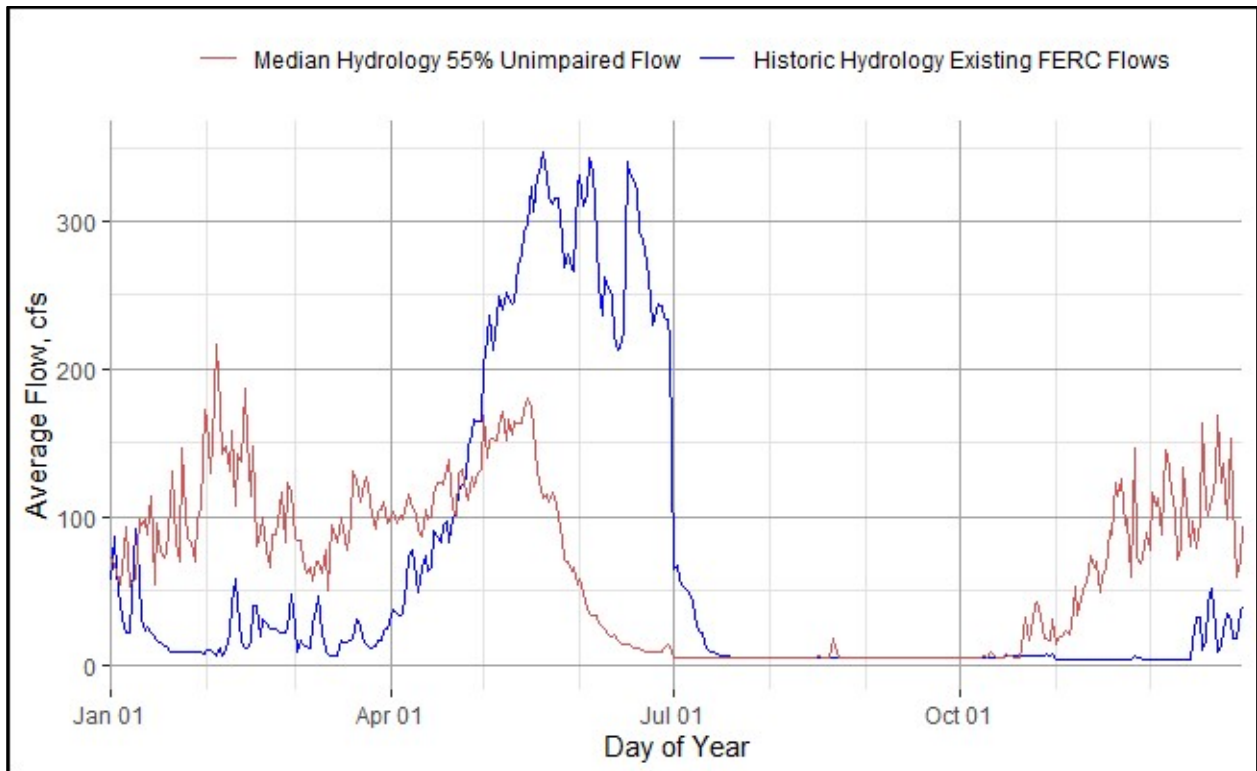


Figure 8 - Daily Average Flow in Bear River below Rollins

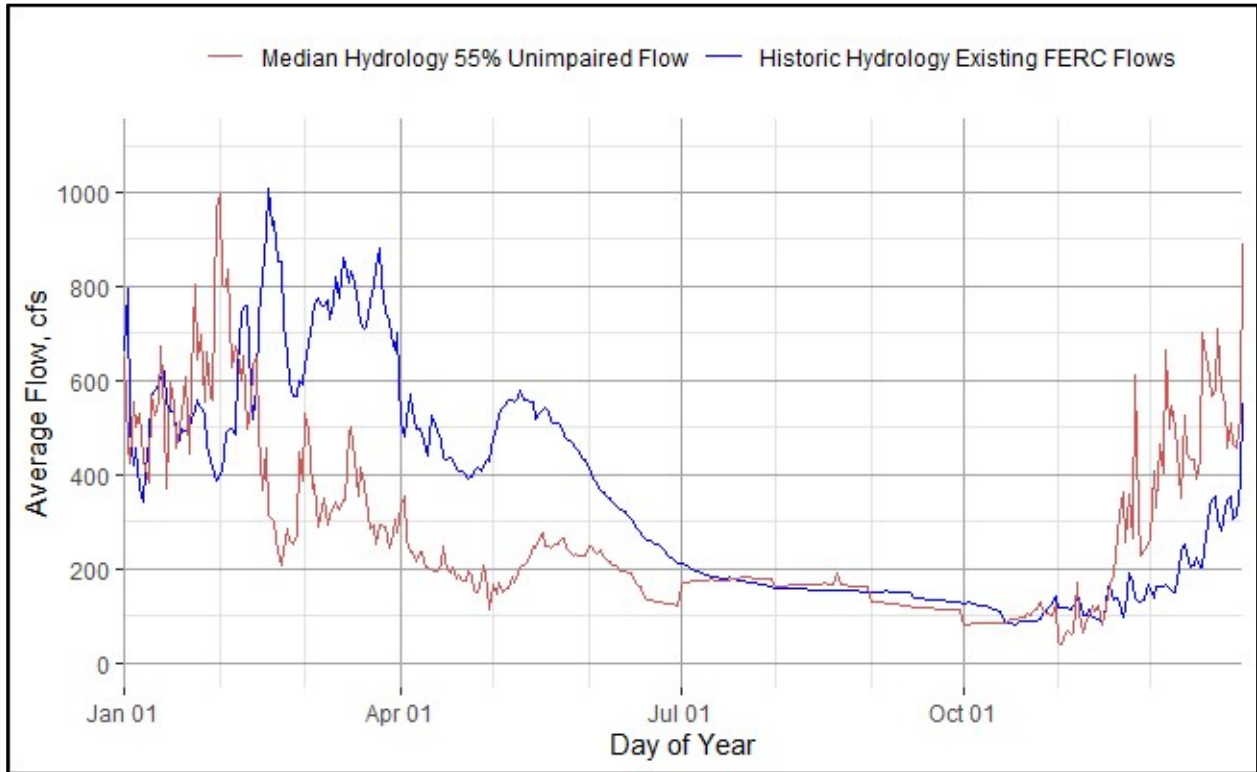
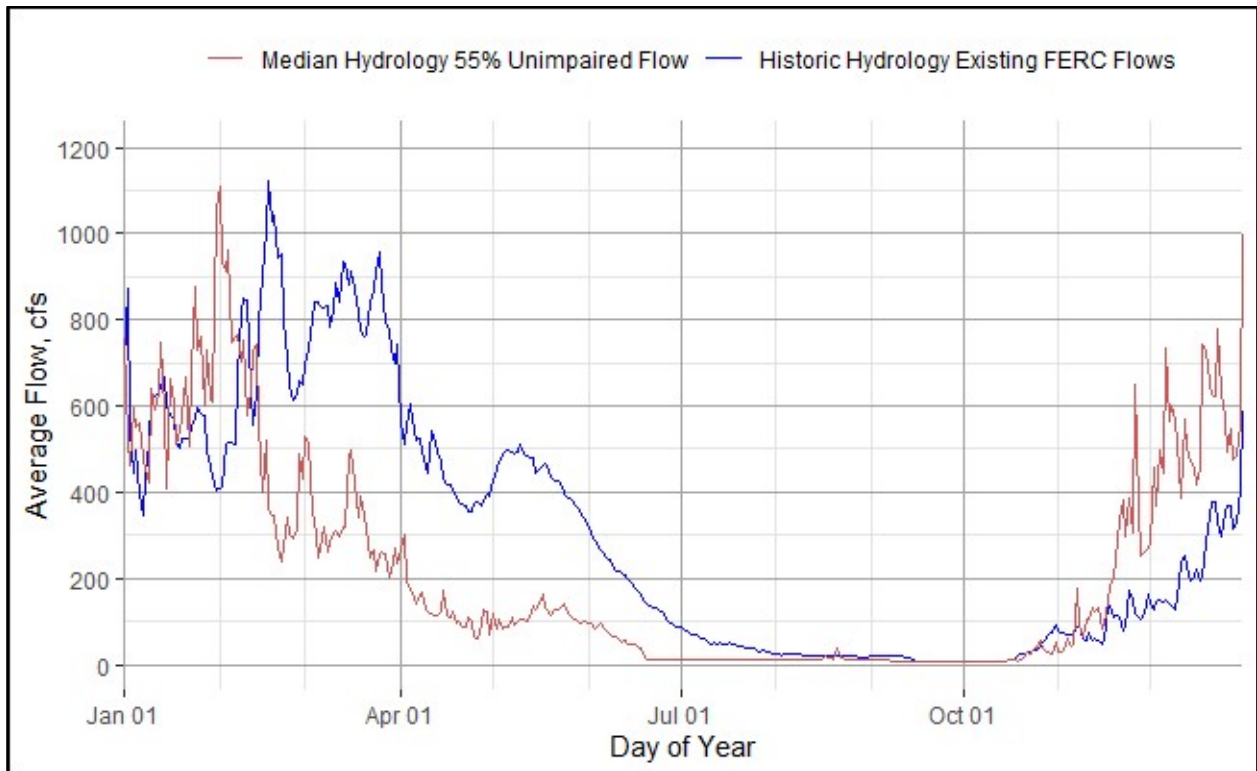


Figure 9 - Daily Average Flow in Bear River below Lake Combie



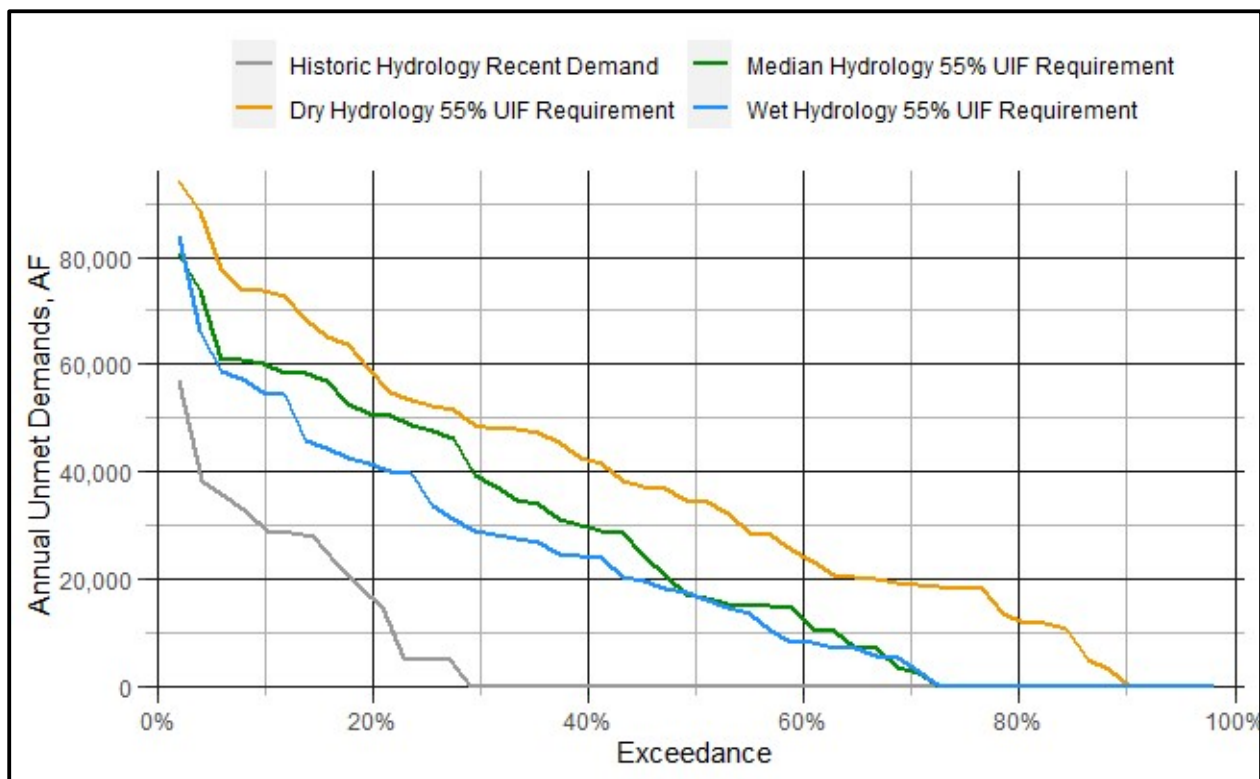
Figures 6 and 7 show that the resulting flows below Milton and Bowman of the proposed plan with median hydrology are generally higher than the existing scenario flows in the January through April period until the historical spill season causes existing scenario flows to be higher on average in May through June. Summer flows are equal in both scenarios when 55% of unimpaired flow falls below the existing FERC flow requirements in July through September.

Figures 8 and 9 show that the resulting flows below Rollins and Combie are almost always lower than the existing scenario, with the general exception of November through December. This is due to a reduction in Middle and South Yuba exports to the Bear River. Under the proposed flow regime, more of the unimpaired flow stays in the native rivers. This results in significantly less generation in the Bear River watershed and less water available for delivery.

## Deliveries

An exceedance of unmet consumptive demands is shown in Figure 10. Unmet consumptive demands are defined here as a reduction in diversions into NID canals below what would be needed to make full deliveries to customers.

*Figure 10 - Annual Unmet Consumptive Demands Exceedance*



## Storage

Figures 11 through 20 illustrate storage differences by year type between the historic operations and the climate change projected hydrology coupled with the 55% flow bypass requirements.

Figure 11 shows the average April 30<sup>th</sup> storage at Jackson Meadows Reservoir by year type for each scenario. The existing storage levels illustrate a slightly lower storage level than the climate change scenarios in wet years and higher storage level in non-wet years. For wet years this is due to the runoff patterns within the hydrology datasets. The climate change hydrology provides a greater percentage of the annual volume before April 30<sup>th</sup> than the historic hydrology used in the existing condition scenario. The result is that the climate change scenarios tend to have more storage on April 30<sup>th</sup>. However, in drier years the previous year's lower carryover level results in lower April 30<sup>th</sup> storage level.

*Figure 11 - Jackson Meadows Reservoir April 30 Storage, Averaged by Water Year Type*

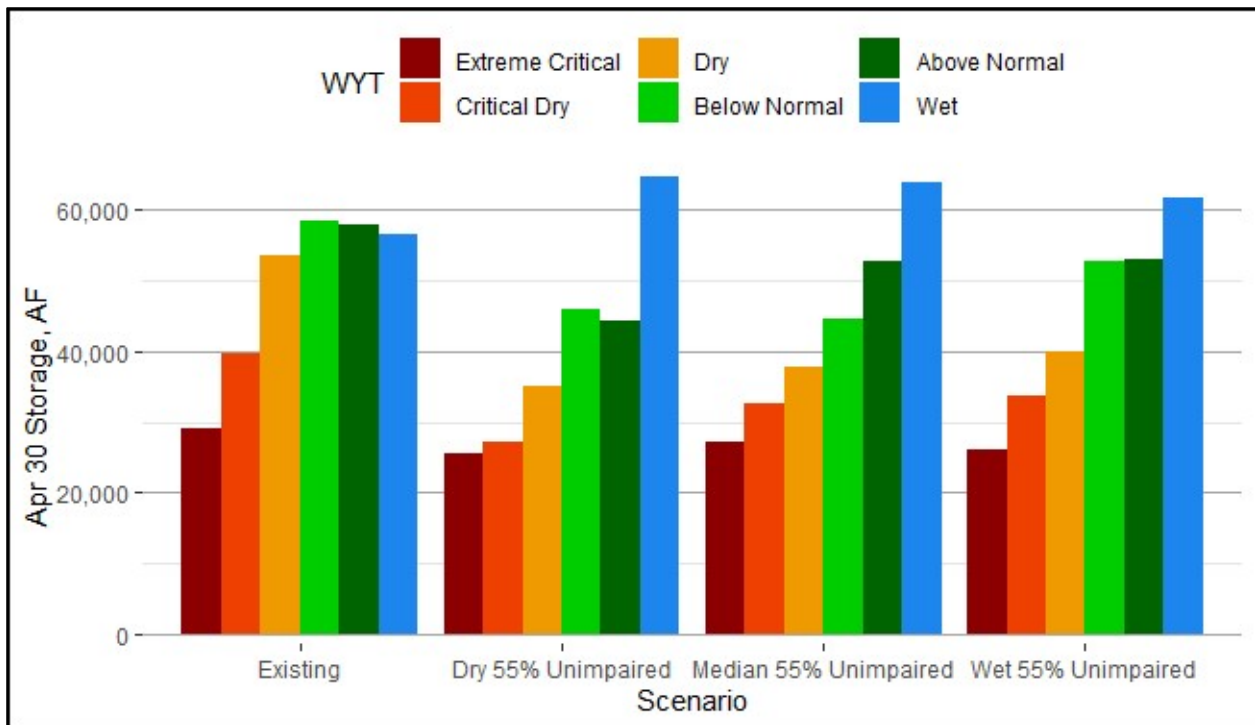


Figure 12 shows the Jackson Meadows November 1 storage. Because the runoff pattern in the historic hydrology dataset provides water supply later into the water year, the reliance of storage into the late spring and early summer is less in the existing study than in the climate change scenarios. This generally results in a higher November 1 storage in the existing scenario. Additionally, the scenarios with a 55% unimpaired flow requirement draw Jackson Meadows Reservoir down to minimum pool more often to maintain water supply.

Figure 12 - Jackson Meadows Reservoir November 1 Storage, Averaged by Water Year Type

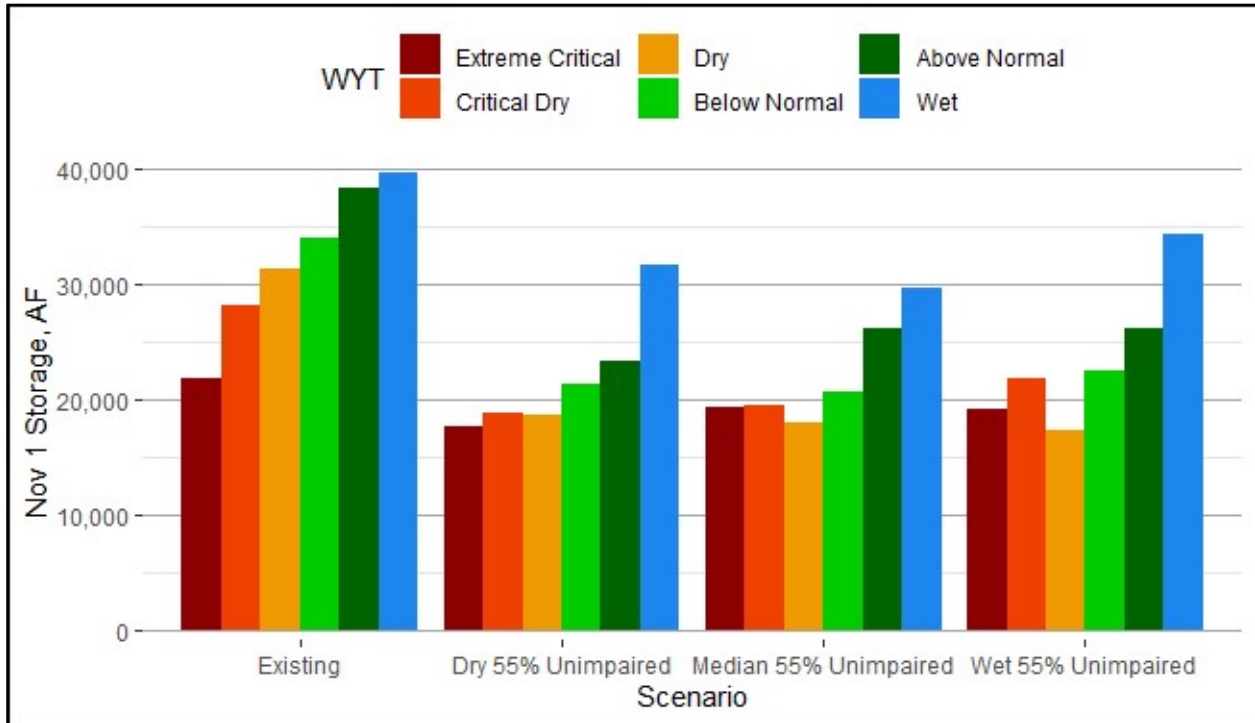


Figure 13 illustrates the Bowman Lake April 30<sup>th</sup> storage. As with Jackson Meadows, the largest factors in the storage shifts are the lower carryover levels in the previous year.

Figure 13 - Bowman Lake April 30 Storage, Averaged by Water Year Type

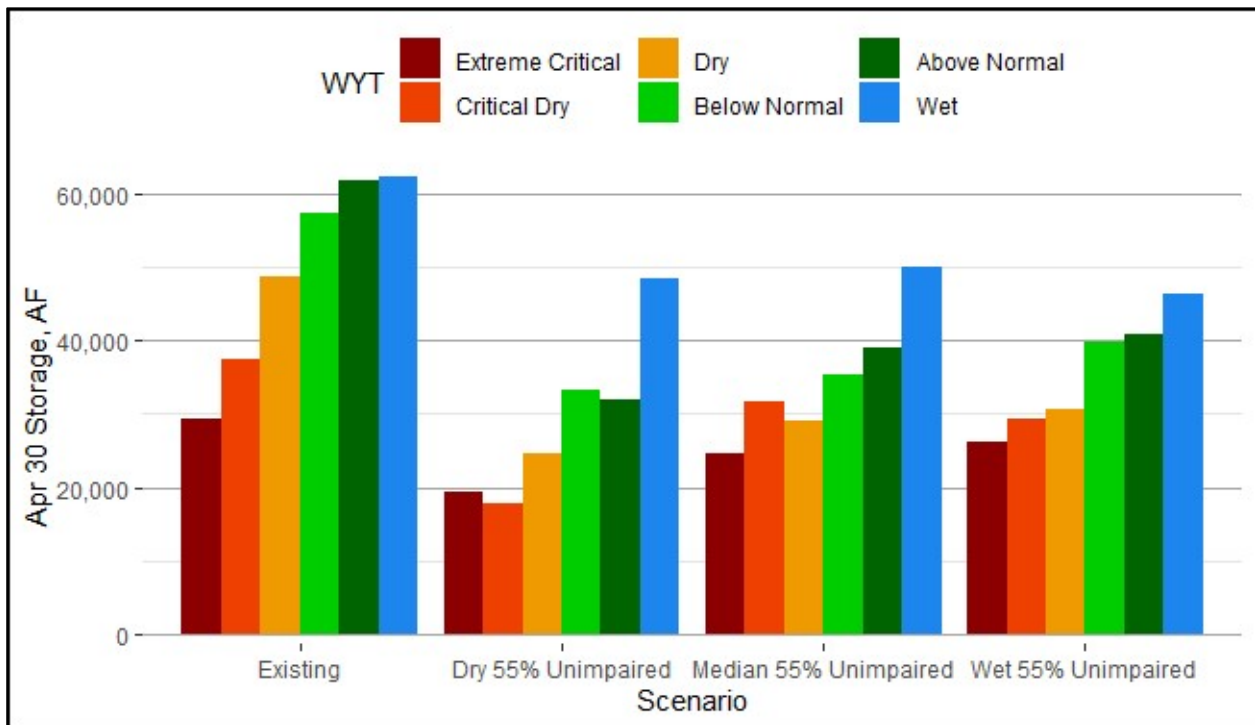


Figure 14 shows the Bowman Lake November 1 storage. Like Jackson Meadows, the runoff pattern in the historic hydrology dataset provides water supply later into the water year. There is less reliance on storage into the late spring and early summer in the existing study than in the climate change scenarios. This generally results in a higher November 1 storage in the existing scenario.

*Figure 14 - Bowman Lake November 1 Storage, Averaged by Water Year Type*

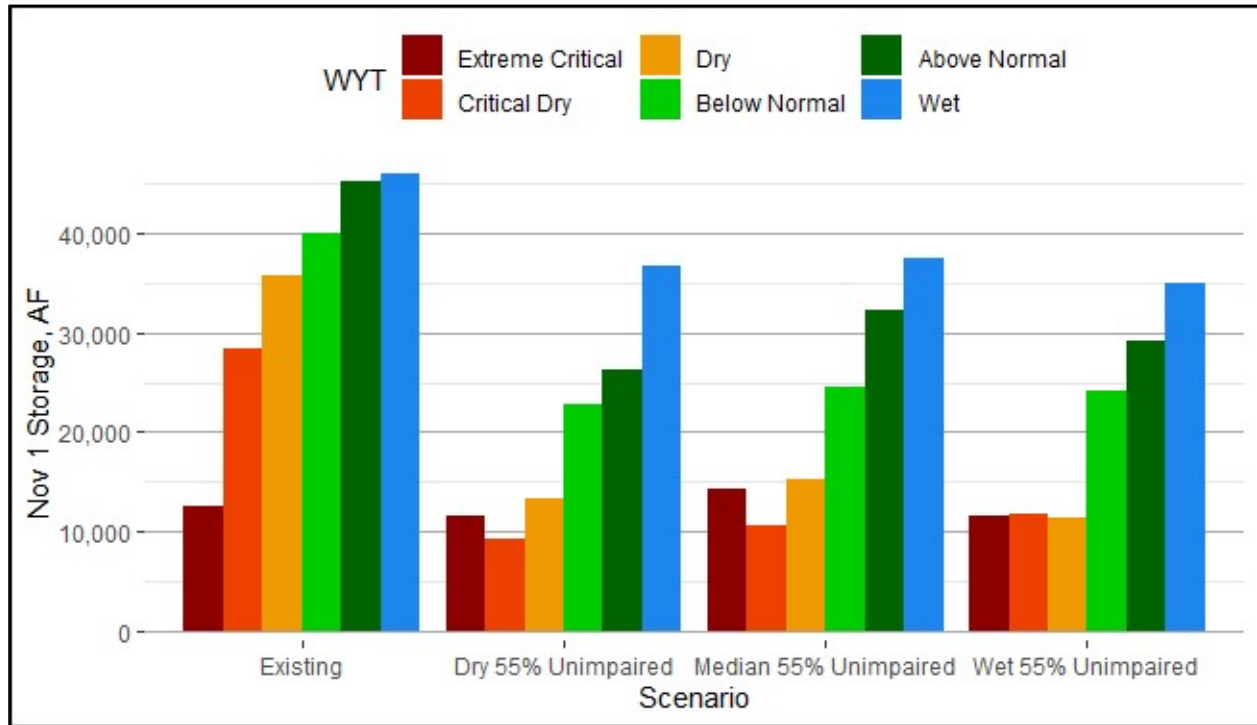


Figure 15 illustrates the Upper Mountain Division storage as a total. The April 30<sup>th</sup> storage levels are lower with the 55% unimpaired scenarios due to lower carryover storage levels in previous years. Figure 16 illustrates the November 1 Upper Mountain Division storage.

Figure 15 - Upper Mountain Division Storage (French, Faucherie, Sawmill, and Jackson Lakes) April 30 Storage, Averaged by Water Year Type

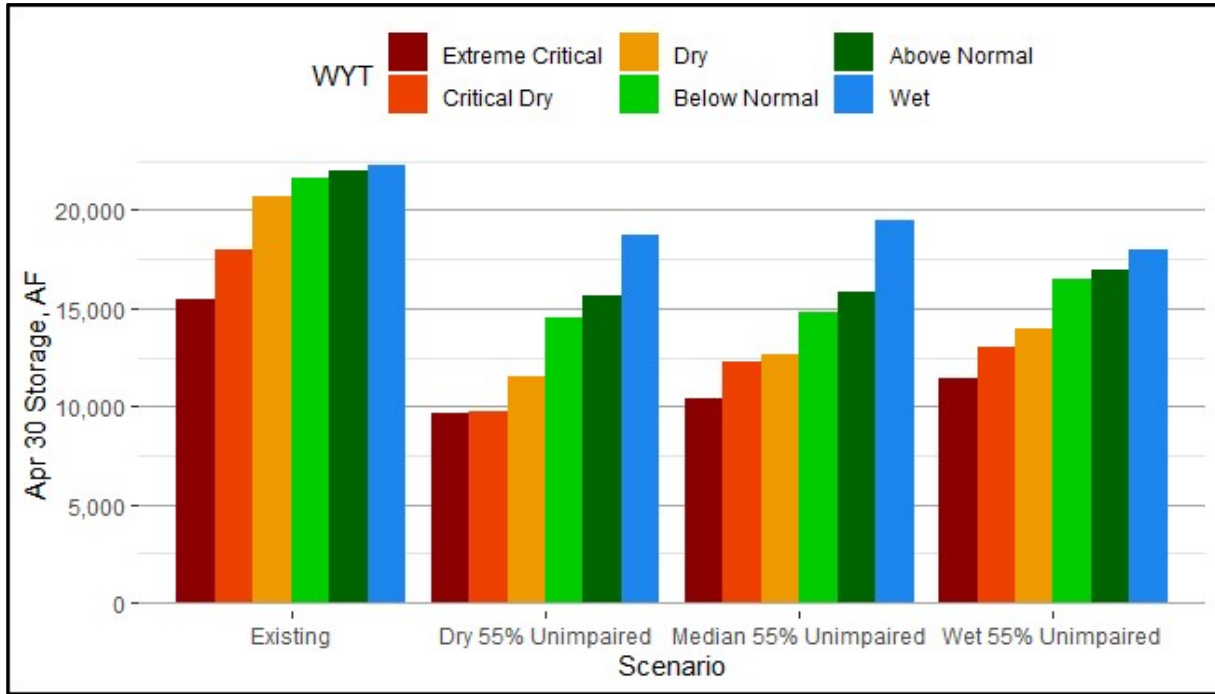


Figure 16 - Upper Mountain Division Storage (French, Faucherie, Sawmill, and Jackson Lakes) November 1 Storage, Averaged by Water Year Type

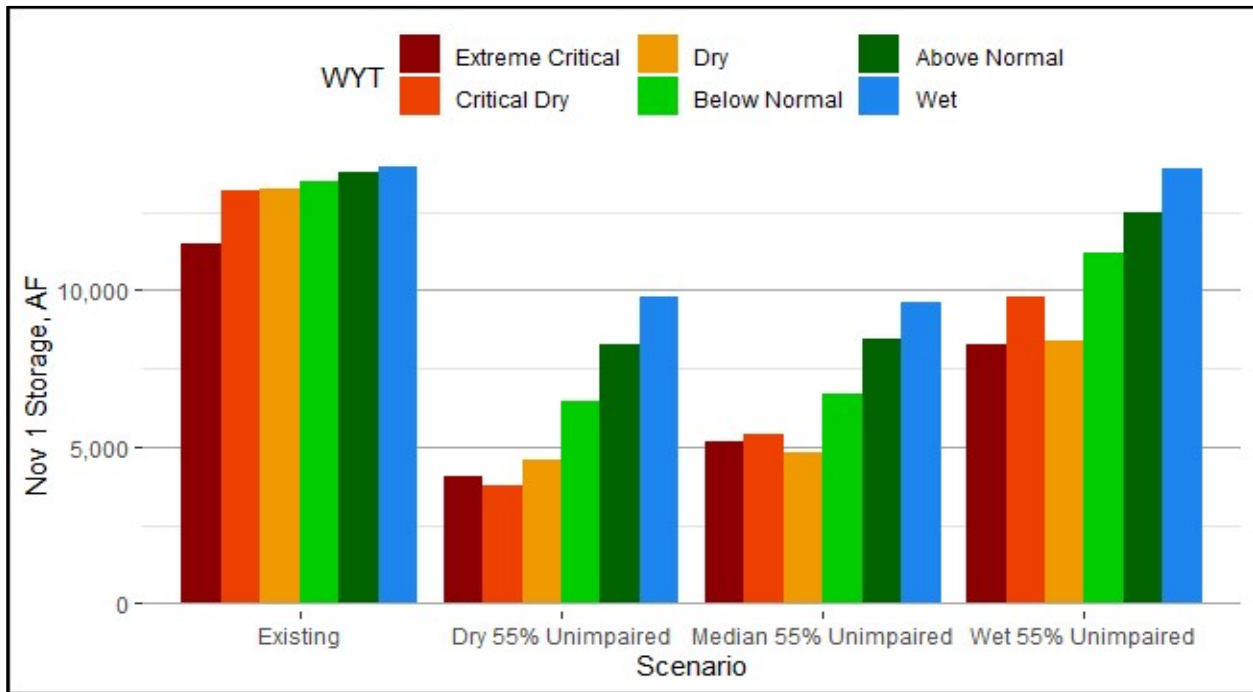


Figure 17 illustrates Scott’s Flat April 30<sup>th</sup> storage. The proposed plan impacts Scott’s Flat operations more than any other reservoir. The impacts are due to a large reduction in imports from the Yuba River. The proposed plan results in 55% of the unimpaired inflow staying in the native streams rather than being imported through the Bowman Spaulding Conduit and delivered to Scott’s Flat. This results in a significant decrease in storage and consumptive deliveries along Deer Creek.

*Figure 17 - Scotts Flat Reservoir April 30 Storage, Averaged by Water Year Type*

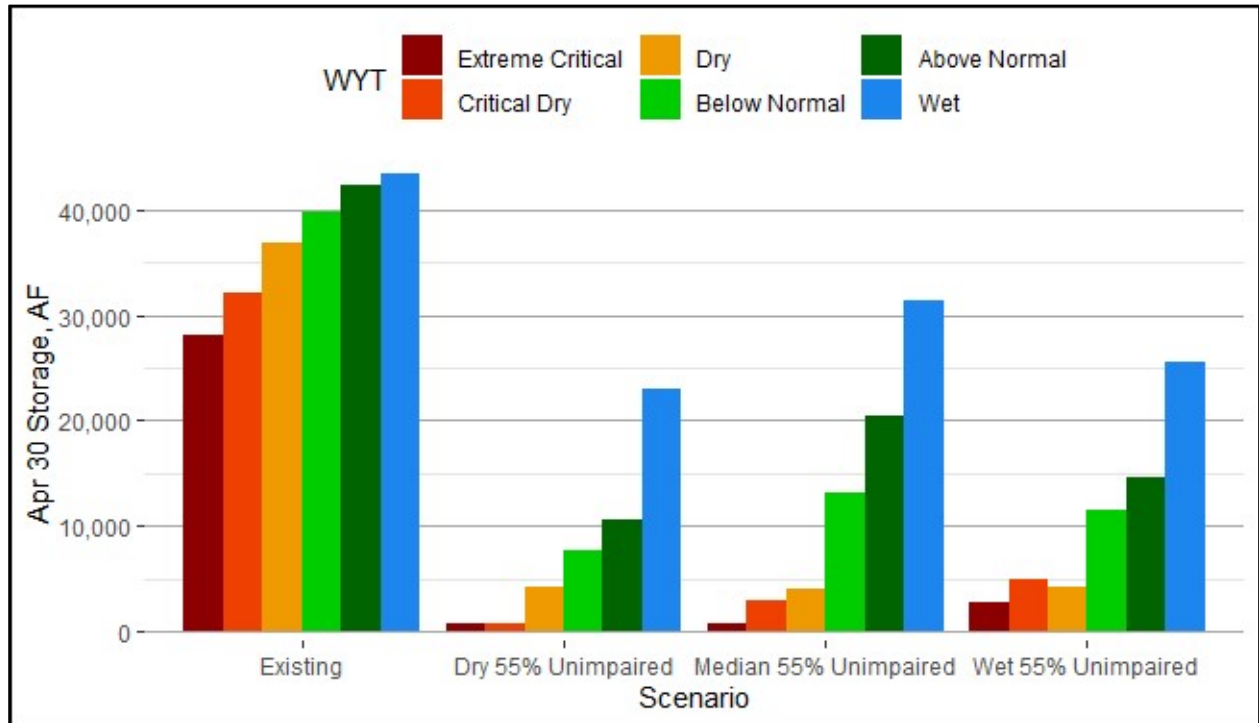


Figure 18 illustrates the same decrease in storage on November 1.

Figure 18 - Scotts Flat Reservoir November 1 Storage, Averaged by Water Year Type

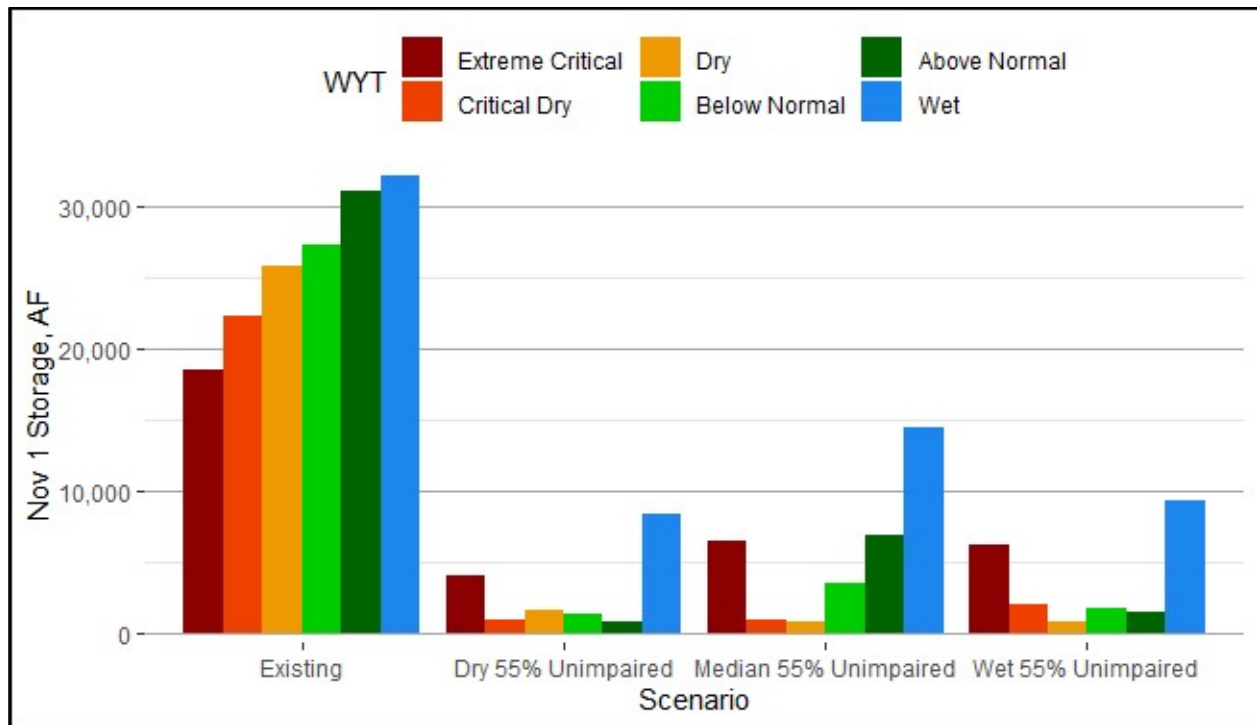


Figure 19 illustrates the NID portion of Rollins Reservoir Storage. Rollins April 30th storage is impacted by runoff patterns, and in the case of the proposed plan scenarios, the reduction in imports to the Bear River and 55% of unimpaired bypass flows on the Bear River. In addition, Rollins reservoir operations are primarily for meeting consumptive deliveries and the model is attempting full deliveries in each year. The deliveries, bypass requirements, and the Mountain Division releases influence Rollins Reservoir storage.

Figure 19 – Rollins Reservoir April 30 NID Only Storage, Averaged by Water Year Type

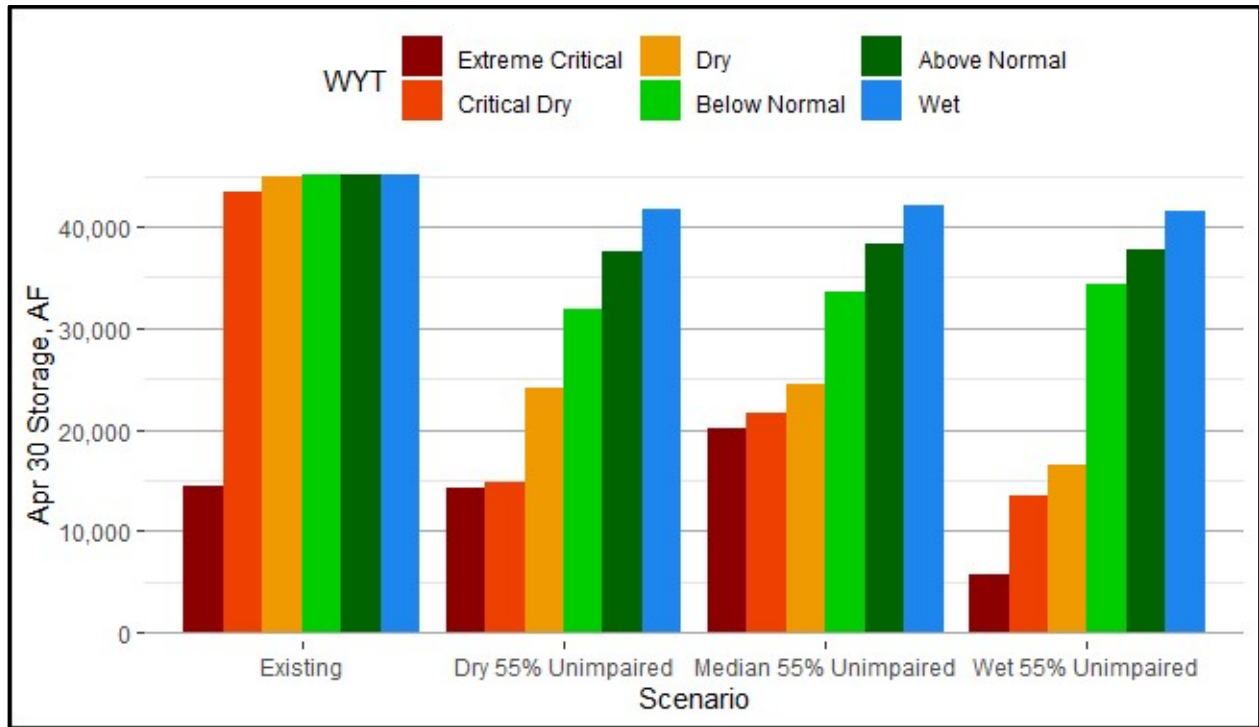
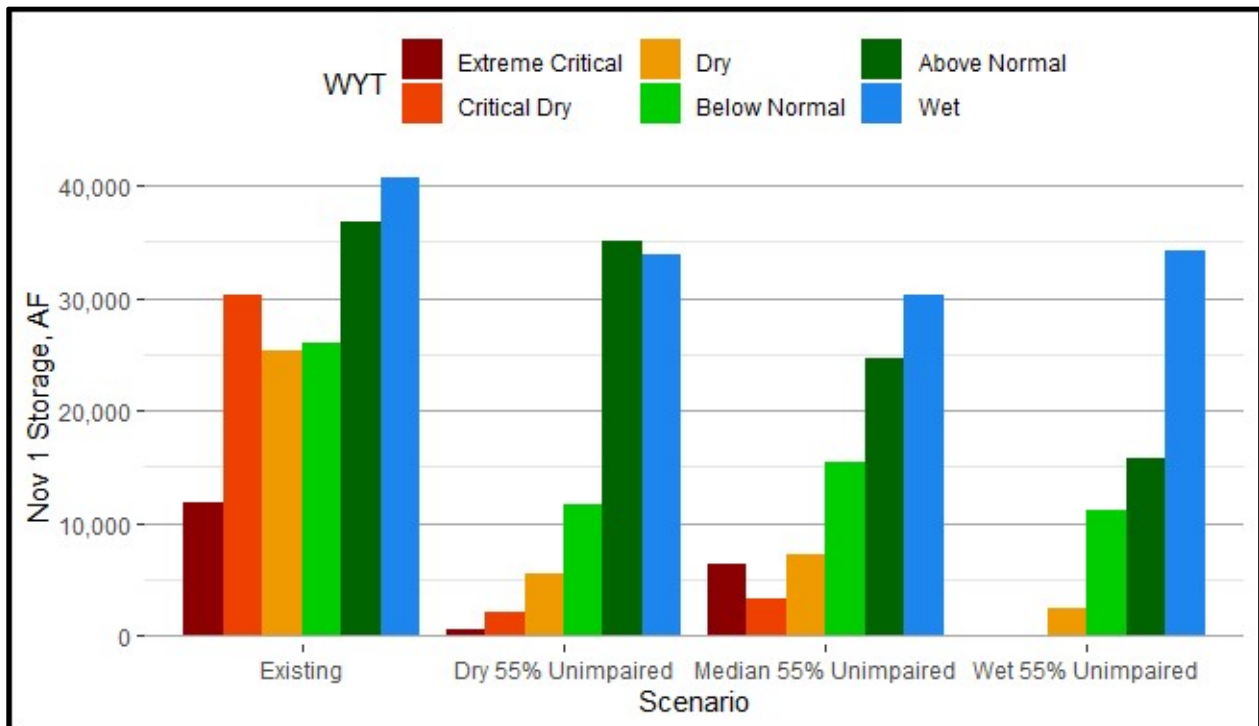


Figure 20 illustrates the November 1 NID storage at Rollins Reservoir. The model is making full deliveries each year with less imported water than in the existing condition, resulting in less storage on November 1 in the 55% unimpaired flow condition.

Figure 20 - Rollins Reservoir November 1 NID Only Storage, Averaged by Water Year Type



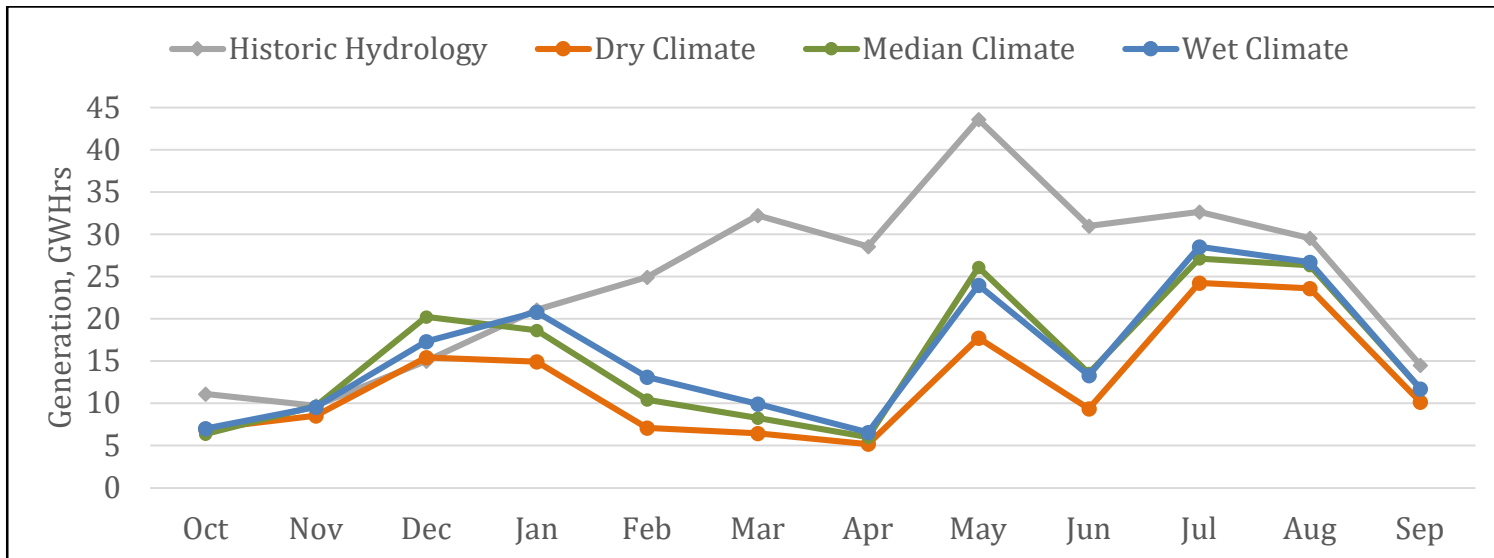
## Generation

Table 8 and Figure 21 illustrate the impacts to generation. Most of the impacts are due to a significant reduction in imports to the Bear River from the Bowman-Spaulding Conduit. If the compliance point for the proposed plan is at the mouth of each river (Middle Yuba, Canyon Creek, South Yuba & Bear River), there will be a significant impact to both water supply and generation.

*Table 8 -Monthly Average Generation*

Scenario	Annual NID Generation GWHrs	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Existing Conditions	293.9	21.1	24.9	32.2	28.6	43.6	31.0	32.7	29.6	14.5	11.1	9.7	15.0
PFW Scenario 4-55%	149.7	14.9	7.1	6.5	5.2	17.7	9.4	24.3	23.6	10.2	7.0	8.5	15.4
PFW Scenario 5-55%	184.5	18.6	10.4	8.3	6.0	26.1	13.6	27.1	26.3	11.8	6.4	9.7	20.2
PFW Scenario 6-55%	188.6	20.8	13.1	9.9	6.6	24.0	13.3	28.5	26.7	11.7	7.0	9.6	17.3

*Figure 21 - NID Monthly Average Generation*



## Operations Examples – Three-Year Drought Sequence – Dry Climate Change Scenario

Below is a series of plots showing the modeled project operations during a three-year drought sequence with the dry climate change scenario, both with and without the unimpaired flow requirements. Figure 22 shows operations at Jackson Meadows Reservoir. Compared to the existing condition, the 55% unimpaired flow requirement causes more releases earlier in the season, resulting in lower storage levels at the end of the fill season and less releases for diversion into the system in the summer.

*Figure 22 - Jackson Meadows Reservoir Operations, Dry Climate 2028-2030*

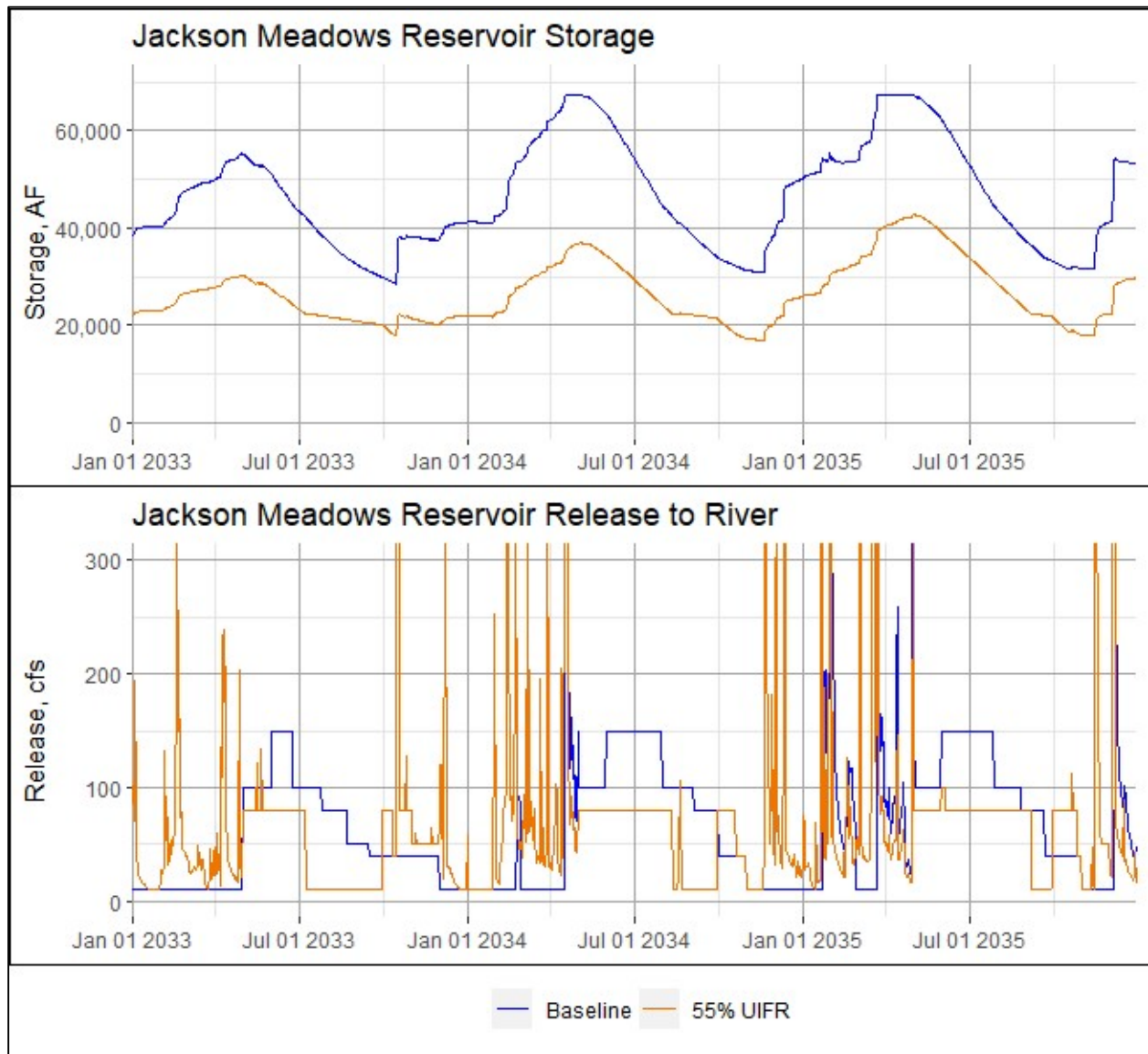


Figure 23 shows operations at French Lake. The releases in the winter and spring cause lower fill levels and reduced ability to release water for downstream diversion during the summer.

Figure 23 - French Lake Operations, Dry Climate 2028-2030

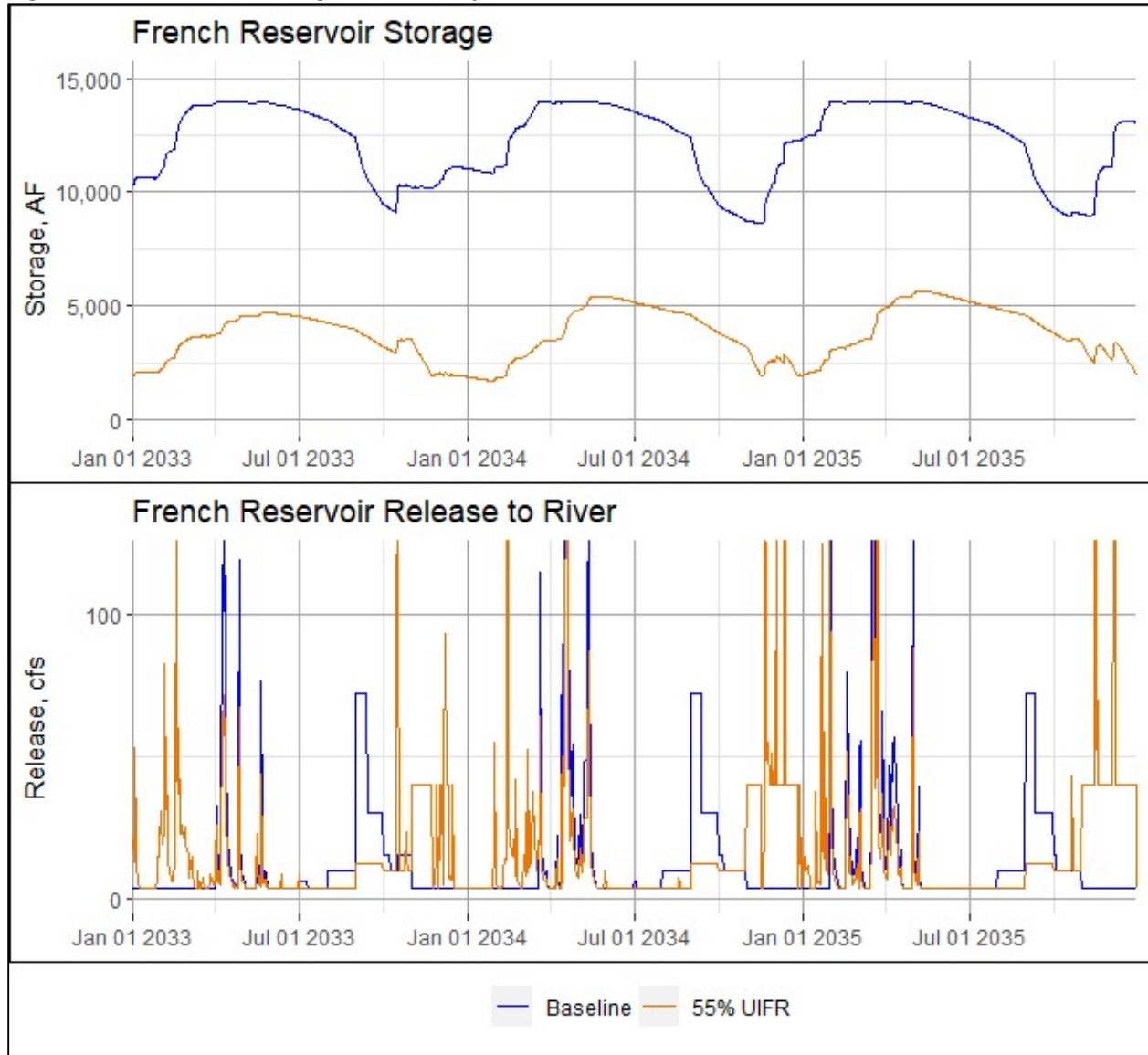


Figure 24 shows operations at Bowman Lake. Bowman Lake storage is highly affected by the combination of increased releases in the winter and spring due to the 55% unimpaired flow requirements and less imports from the Middle Yuba from Jackson Meadows Reservoir. This lower fill level results in less water available for diversions into the NID system.

*Figure 24 - Bowman Lake Operations, Dry Climate 2028-2030*

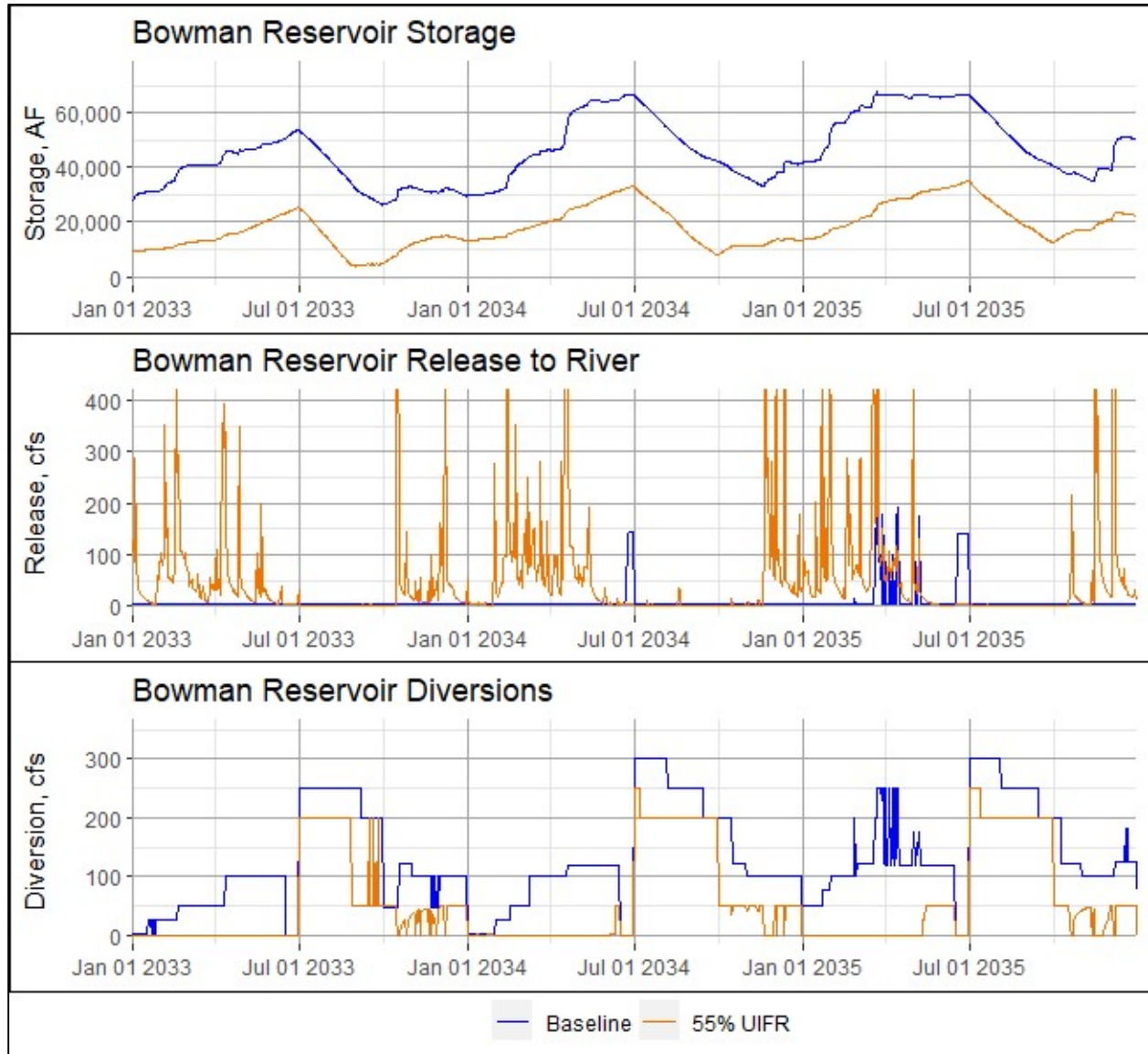


Figure 25 shows operations at Rollins Reservoir. With 55% unimpaired flow requirements and reduced imports from the Yuba River, Rollins does not necessarily fill in Dry Years. This results in less ability to make diversions into the Bear River Canal and less ability to move water down to Lake Combie to maintain Lake Combie reservoir elevations.

*Figure 25 - Rollins Reservoir Operations, Dry Climate 2028-2030*

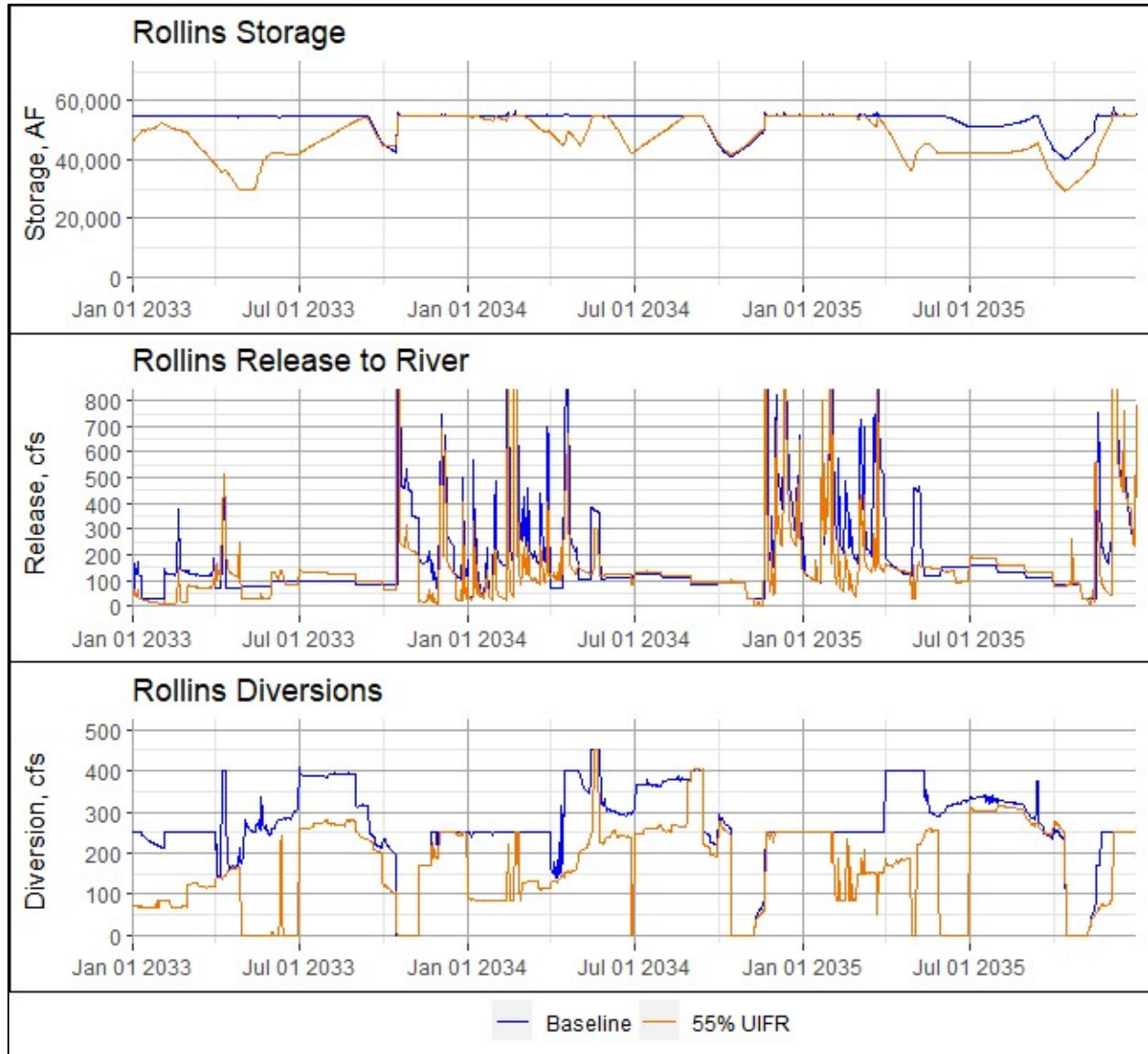


Figure 26 shows operations at Lake Combie. With reduced imports into the Bear River and 55% unimpaired flow requirements while attempting to make full deliveries, Lake Combie cannot maintain a full pool and may not fill in dry years. Here Combie is prioritizing deliveries over maintaining a full storage pool.

Figure 26 - Lake Combie Operations, Dry Climate 2028-2030

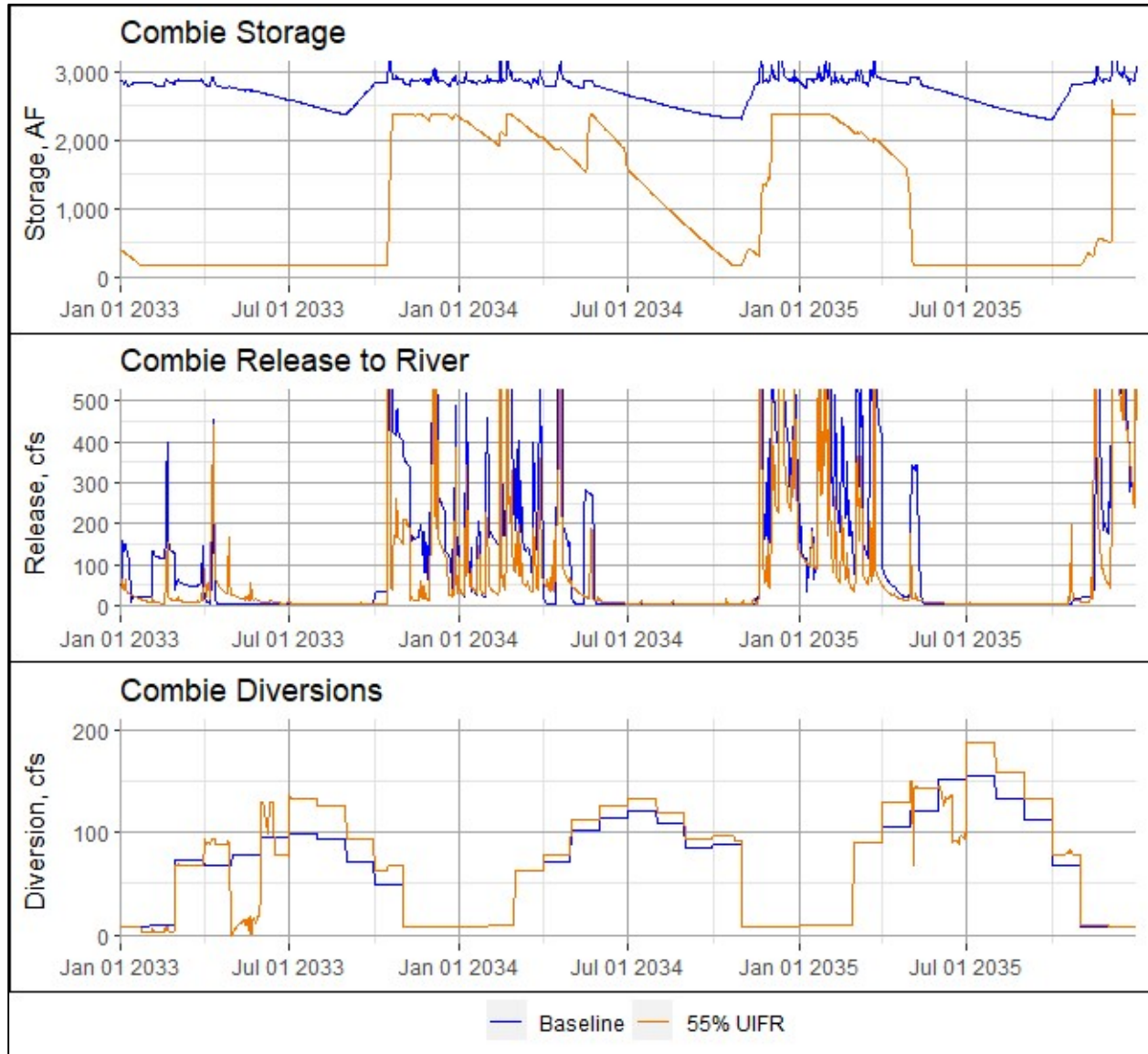
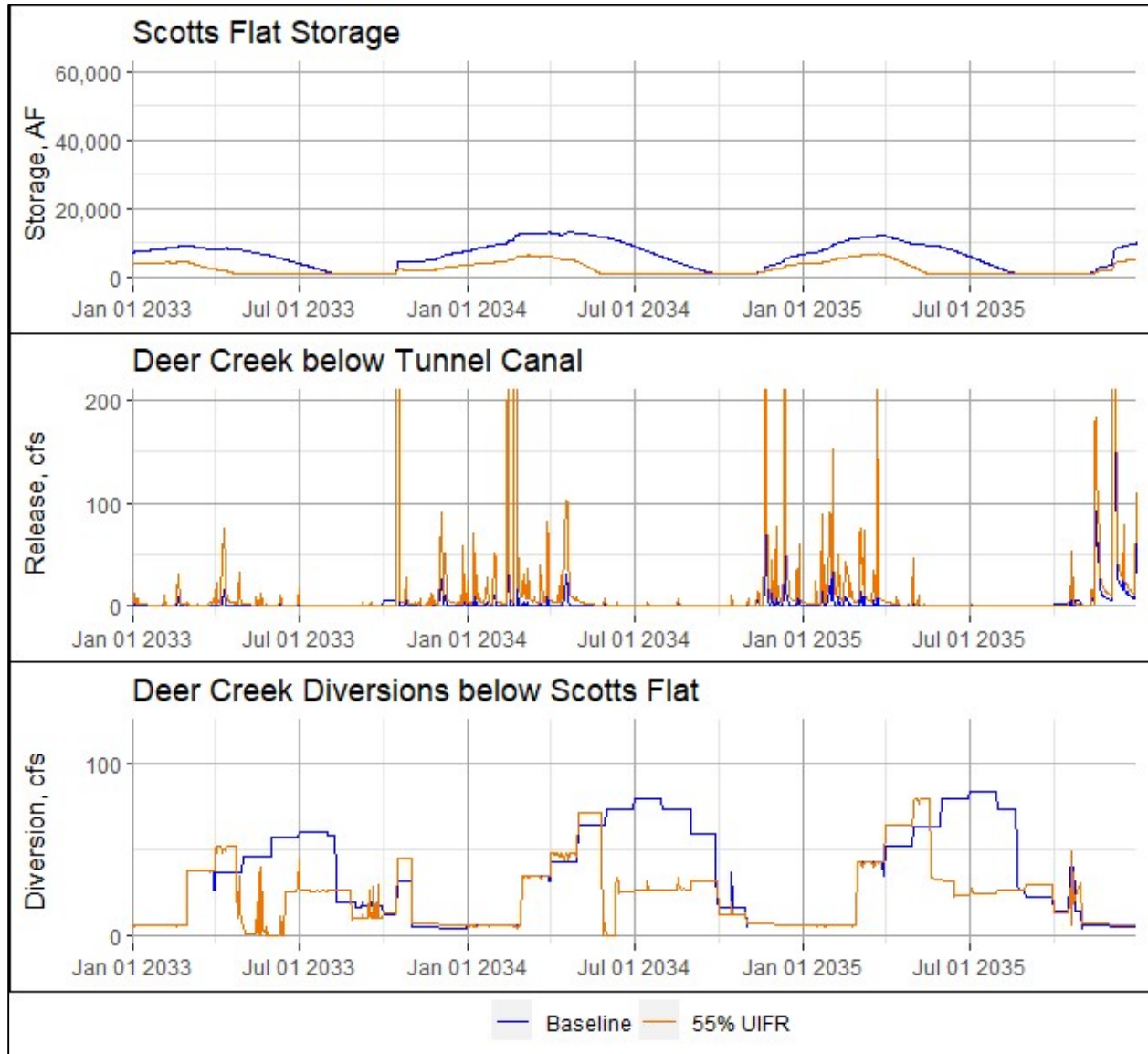


Figure 27 shows operations at Scotts Flat Reservoir. Scotts Flat Reservoir is highly dependent on imports from the Yuba River. The reduction of these imports resulting from loss of supply at upstream reservoirs results in the Reservoir going empty in most dry years which then reduced the ability for the reservoir to make deliveries downstream.

*Figure 27 - Scotts Flat Reservoir Operations, Dry Climate 2028-2030*



## Operations Examples – Three-Year Drought Sequence – Median Climate Change Scenario

Below is a series of plots showing the modeled project operations during a three-year drought sequence with the median climate change scenario, both with and without the unimpaired flow requirements. Figure 28 shows operations at Jackson Meadows Reservoir. Compared to the existing condition, the 55% unimpaired flow requirement causes more releases earlier in the season, resulting in lower storage levels at the end of the fill season and less releases for diversion into the system in the summer.

Figure 28 - Jackson Meadows Reservoir Operations, Median Climate 2038-2040

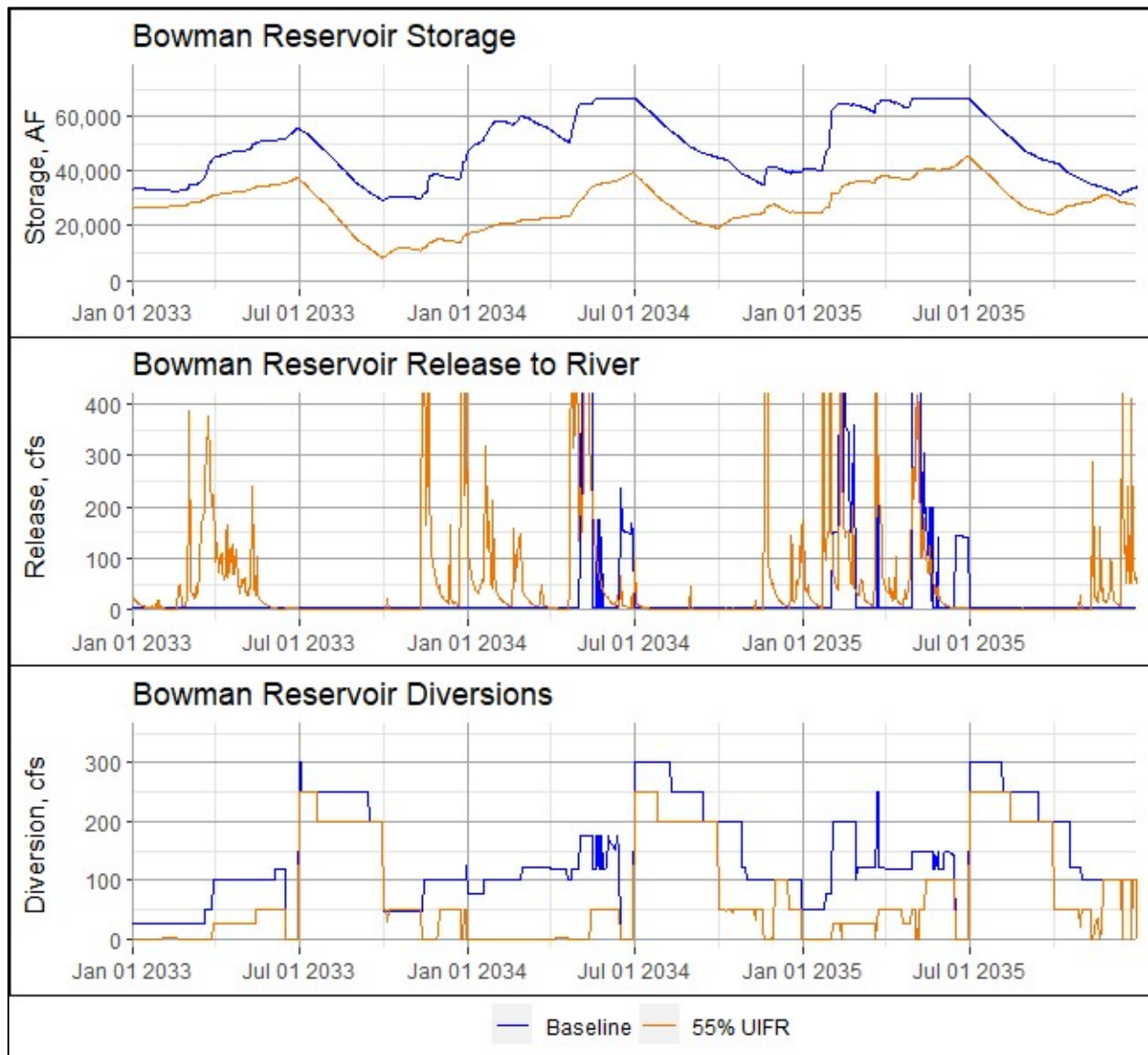


Figure 29 shows operations at French Lake. The releases in the winter and spring cause lower fill levels and reduced ability to release water for downstream diversion during the summer.

Figure 29 - French Lake Operations, Median Climate 2038-2040

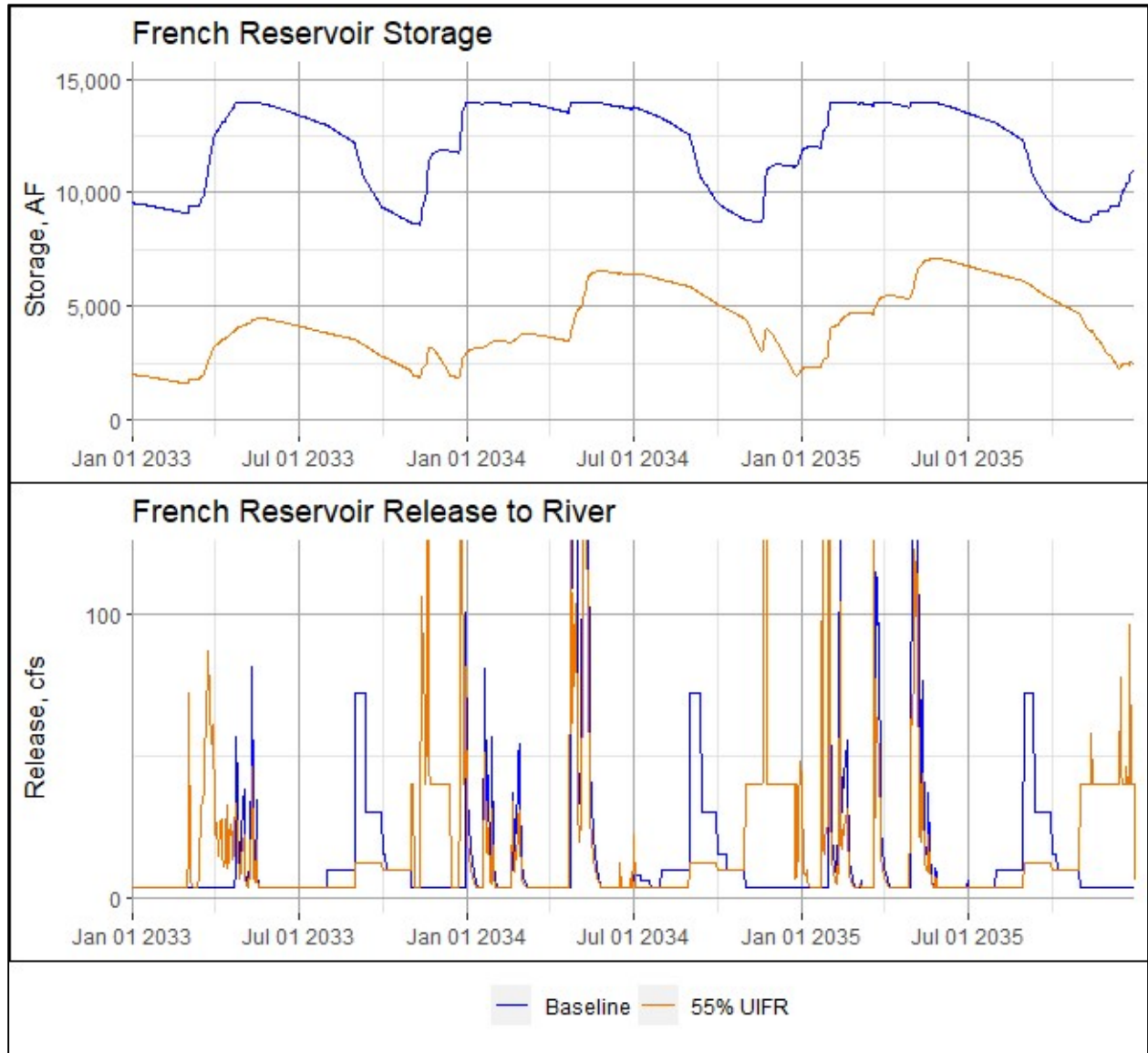


Figure 30 shows operations at Bowman Lake. Bowman Lake storage is highly affected by the combination of increased releases in the winter and spring due to the 55% unimpaired flow requirements and less imports from the Middle Yuba from Jackson Meadows Reservoir. This lower fill level results in less water available for diversions into the NID system.

*Figure 30 - Bowman Lake Operations, Median Climate 2038-2040*

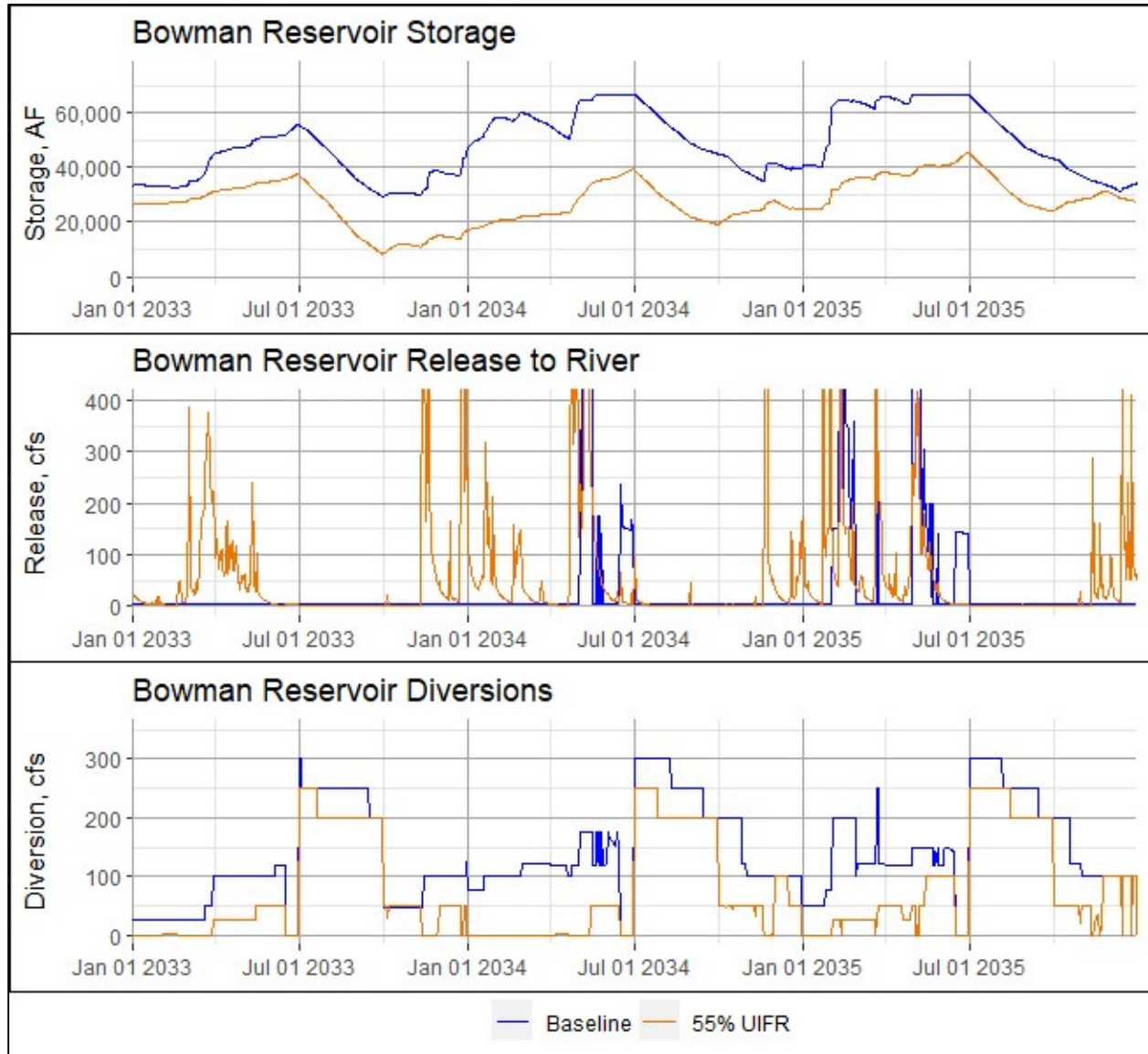


Figure 31 shows operations at Rollins Reservoir. With 55% unimpaired flow requirements and reduced imports from the Yuba River, Rollins does not necessarily stay full in Dry Years. This results in less ability to make diversions into the Bear River Canal and less ability to move water down to Lake Combie to maintain Lake Combie reservoir elevations.

*Figure 31 - Rollins Reservoir Operations, Median Climate 2038-2040*

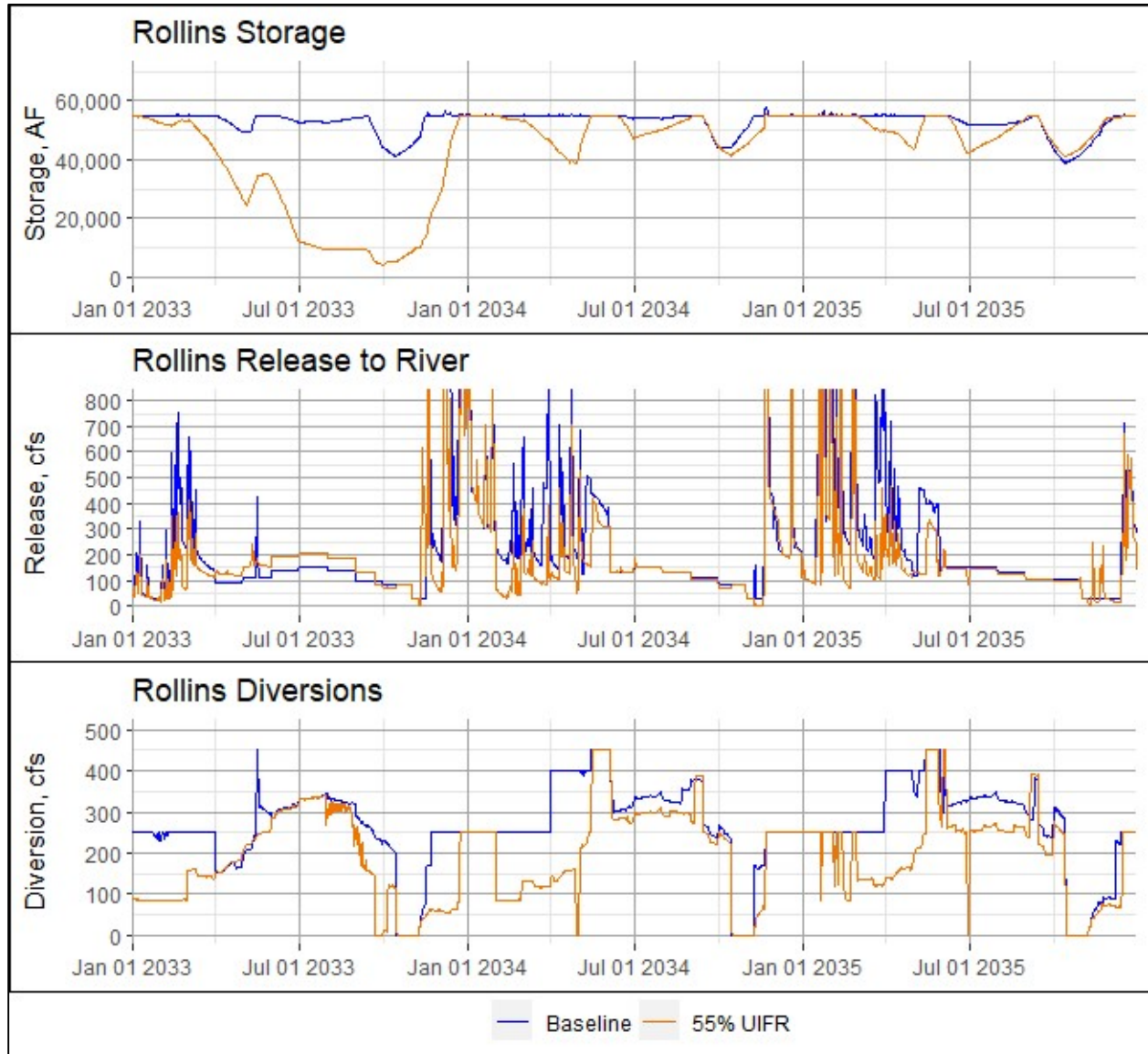


Figure 32 shows operations at Lake Combie. With reduced imports into the Bear River and 55% unimpaired flow requirements Lake Combie cannot maintain a full pool and may not fill in dry years. Here Combie is prioritizing deliveries over maintaining a full storage pool.

*Figure 32 - Lake Combie Operations, Median Climate 2038-2040*

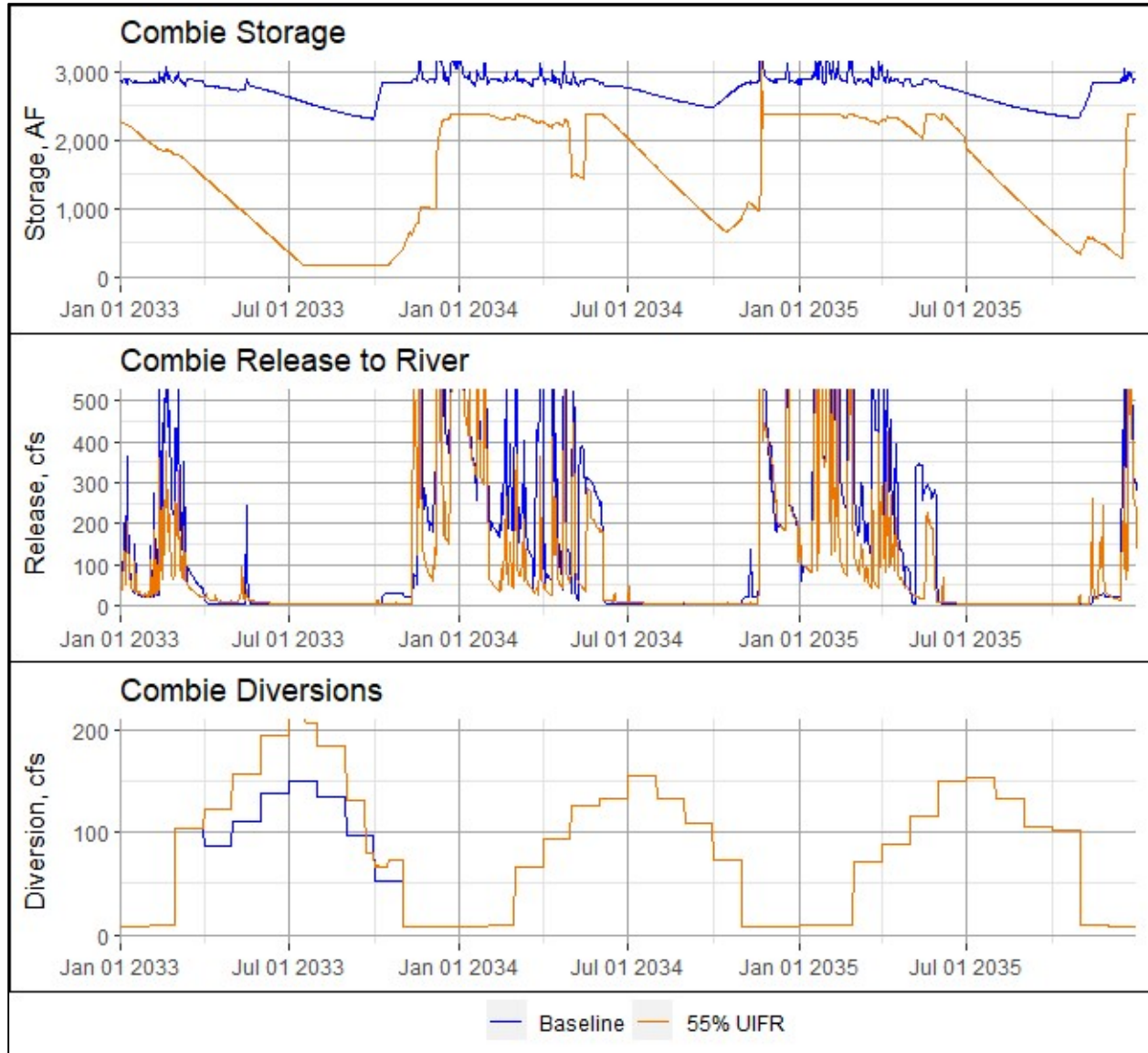
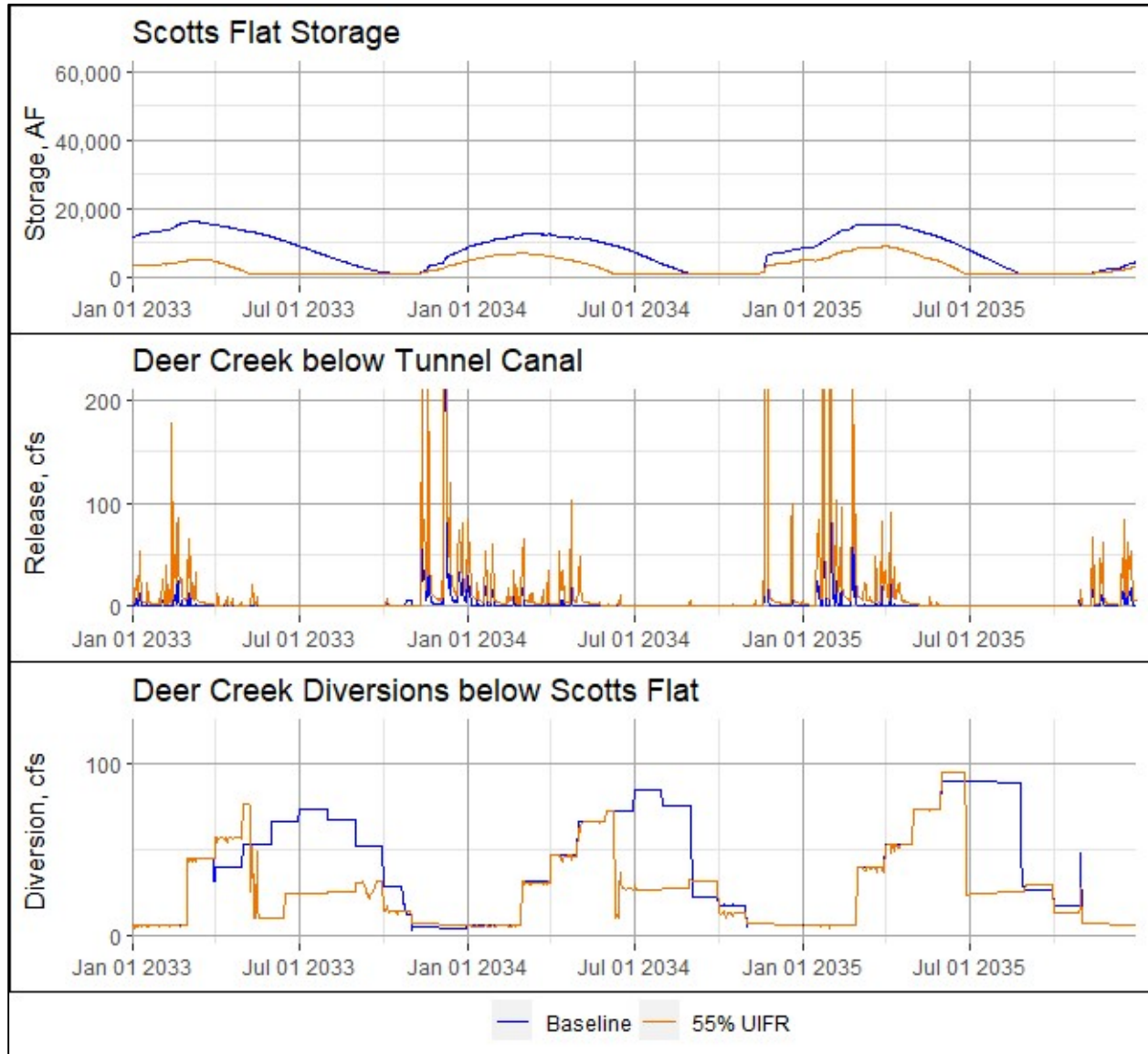


Figure 33 shows operations at Scotts Flat Reservoir. Scotts Flat Reservoir is highly dependent on imports from the Yuba River. The reduction of these imports resulting from loss of supply at upstream reservoirs results in the Reservoir going empty in most dry years which then reduced the ability for the reservoir to make deliveries downstream.

Figure 33 - Scotts Flat Reservoir Operations, Median Climate 2038-2040



## Operations Examples – Three-Year Drought Sequence – Wet Climate Change Scenario

Below is a series of plots showing the modeled project operations during a three-year drought sequence with the wet climate change scenario, both with and without the unimpaired flow requirements. Figure 34 shows operations at Jackson Meadows Reservoir. Compared to the existing condition, the 55% unimpaired flow requirement causes more releases earlier in the season, resulting in lower storage levels at the end of the fill season and less releases for diversion into the system in the summer.

*Figure 34 - Jackson Meadows Reservoir Operations, Wet Climate 2033-2035*

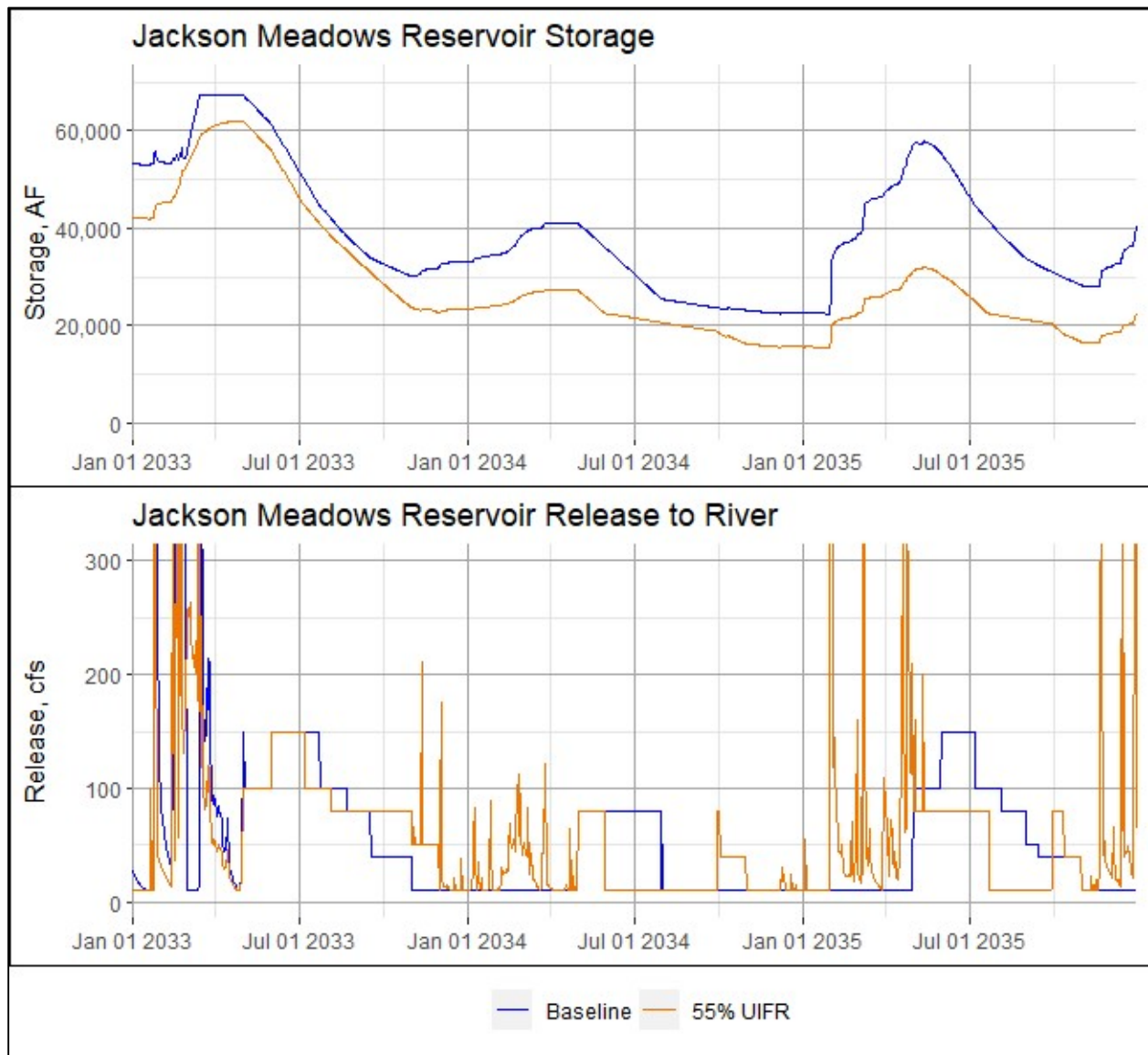


Figure 35 shows operations at French Lake. The releases in the winter and spring cause lower fill levels and reduced ability to release water for downstream diversion during the summer.

*Figure 35 - French Lake Operations, Wet Climate 2033-2035*

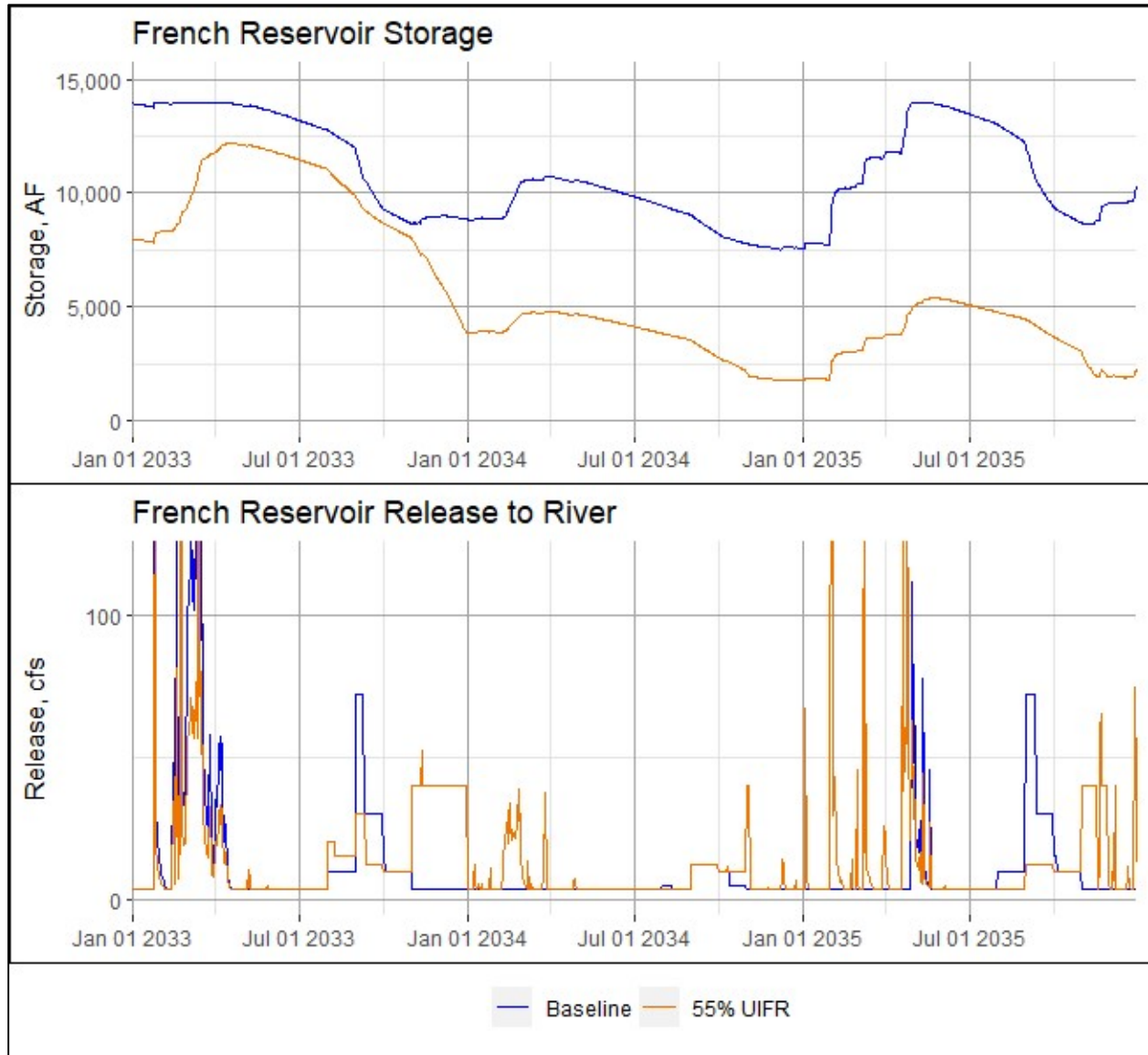


Figure 36 shows operations at Bowman Lake. Bowman Lake storage is highly affected by the combination of increased releases in the winter and spring due to the 55% unimpaired flow requirements and less imports from the Middle Yuba from Jackson Meadows Reservoir. This lower fill level results in less water available for diversions into the NID system.

*Figure 36 - Bowman Lake Operations, Wet Climate 2033-2035*

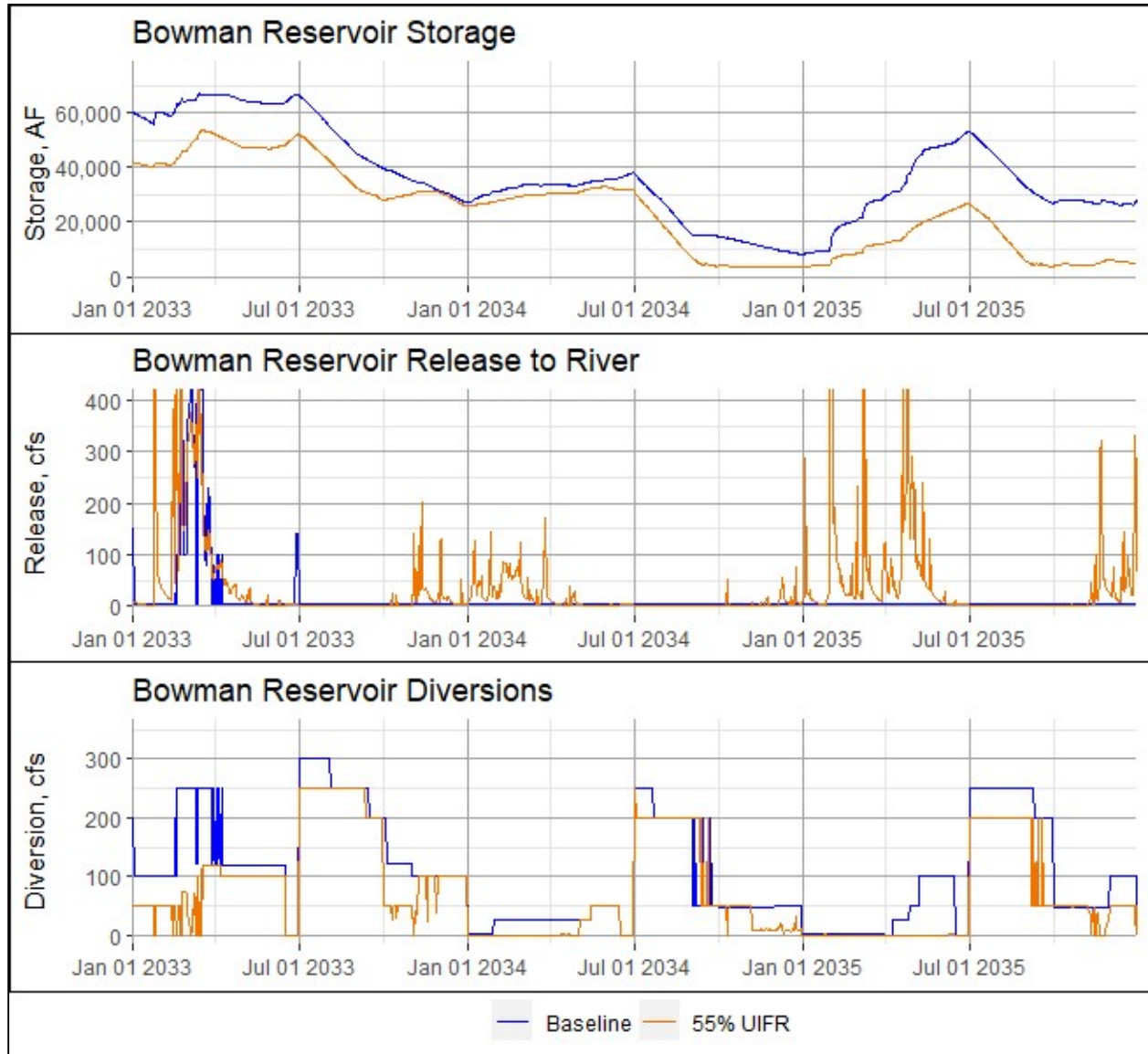


Figure 37 shows operations at Rollins Reservoir. With 55% unimpaired flow requirements and reduced imports from the Yuba River, Rollins does not necessarily fill in Dry Years. This results in less ability to make diversions into the Bear River Canal and less ability to move water down to Lake Combie to maintain Lake Combie reservoir elevations.

*Figure 37 - Rollins Reservoir Operations, Wet Climate 2033-2035*

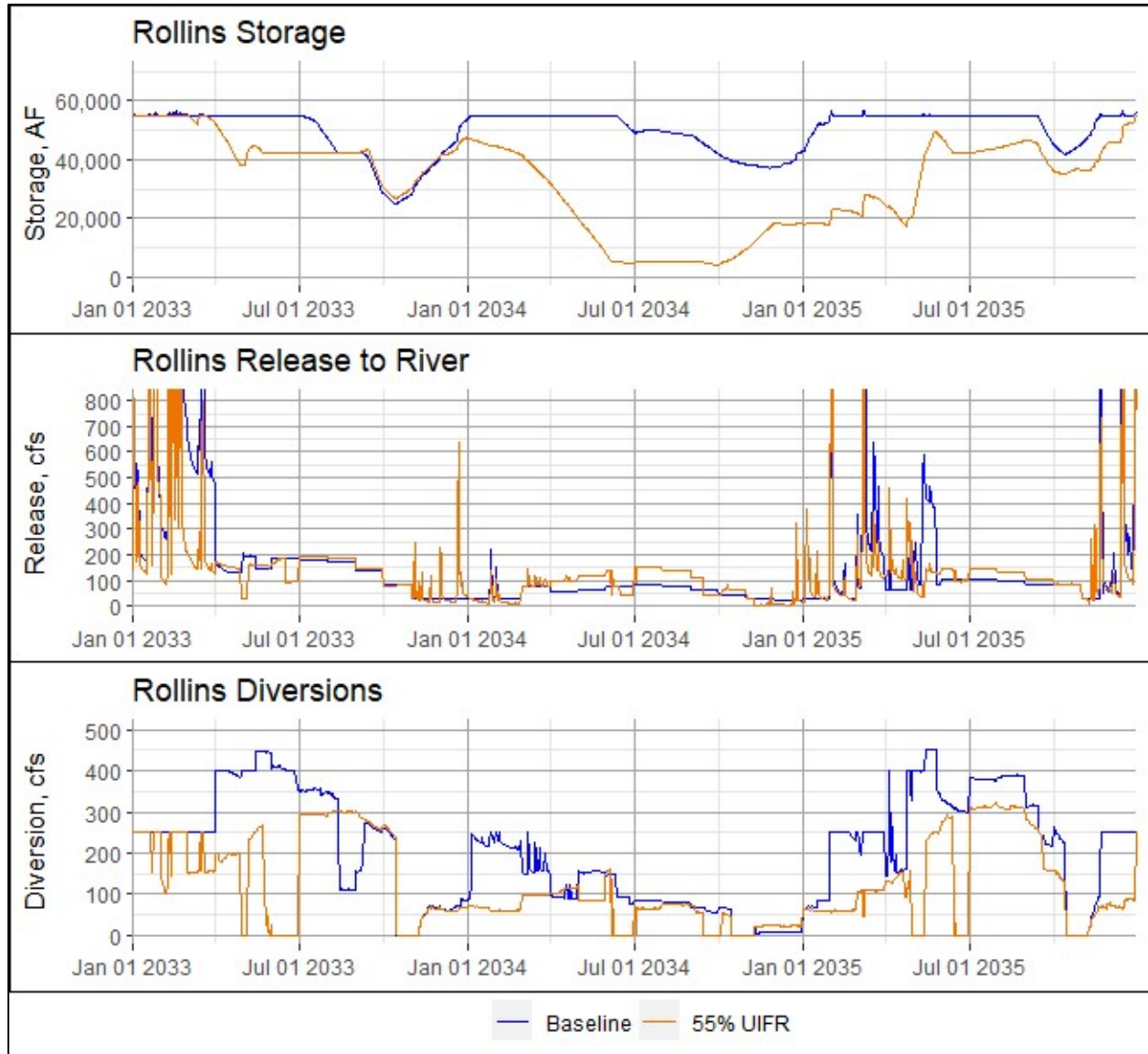


Figure 38 shows operations at Lake Combie. With reduced imports into the Bear River and 55% unimpaired flow requirements Lake Combie cannot maintain a full pool and may not fill in dry years. In a severe dry sequence such as 2033-2035, the combination of hydrology and 55% unimpaired flow requirements prevent Combie from any refill while still maintaining deliveries.

*Figure 38 - Lake Combie Operations, Wet Climate 2033-2035*

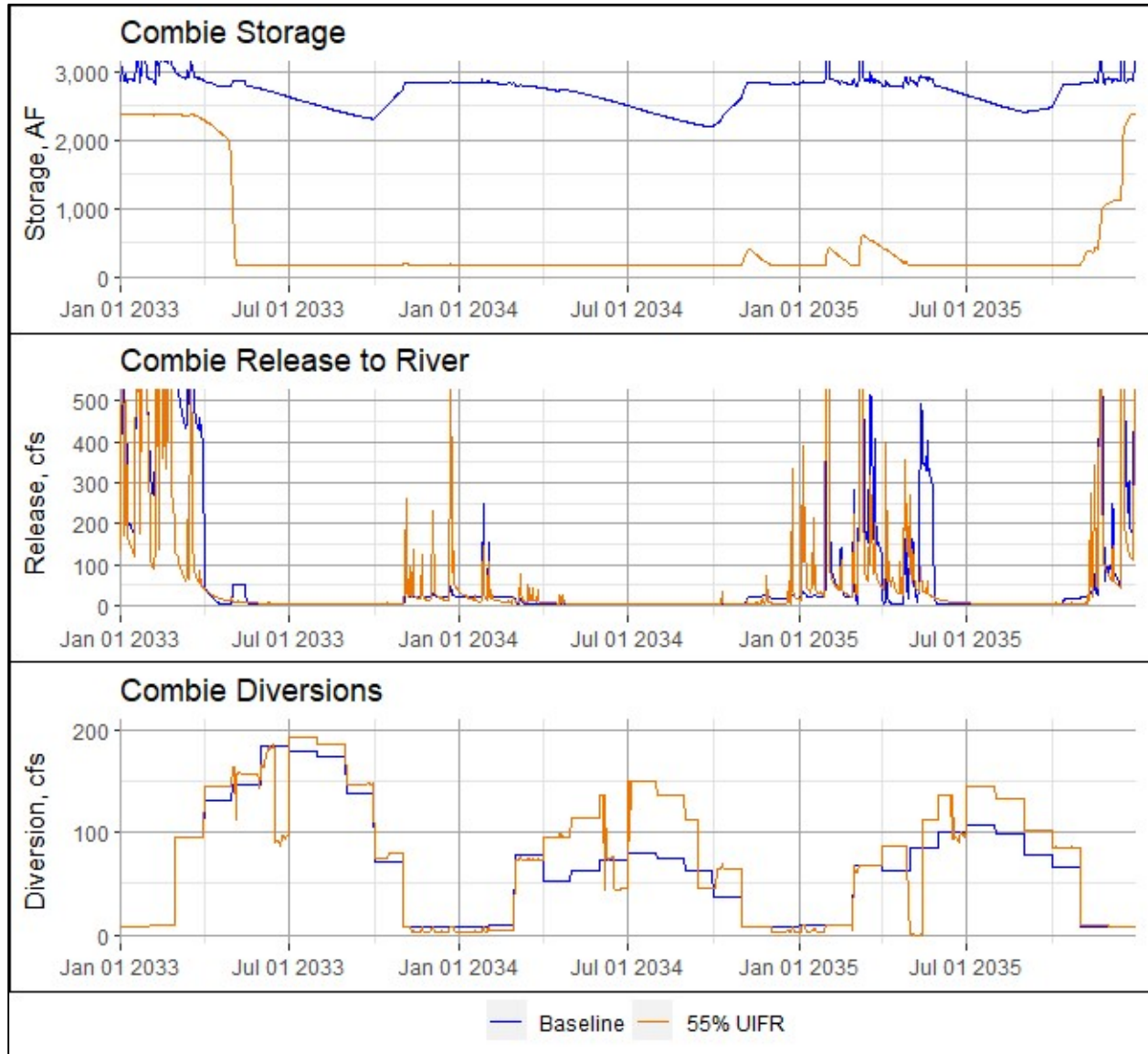
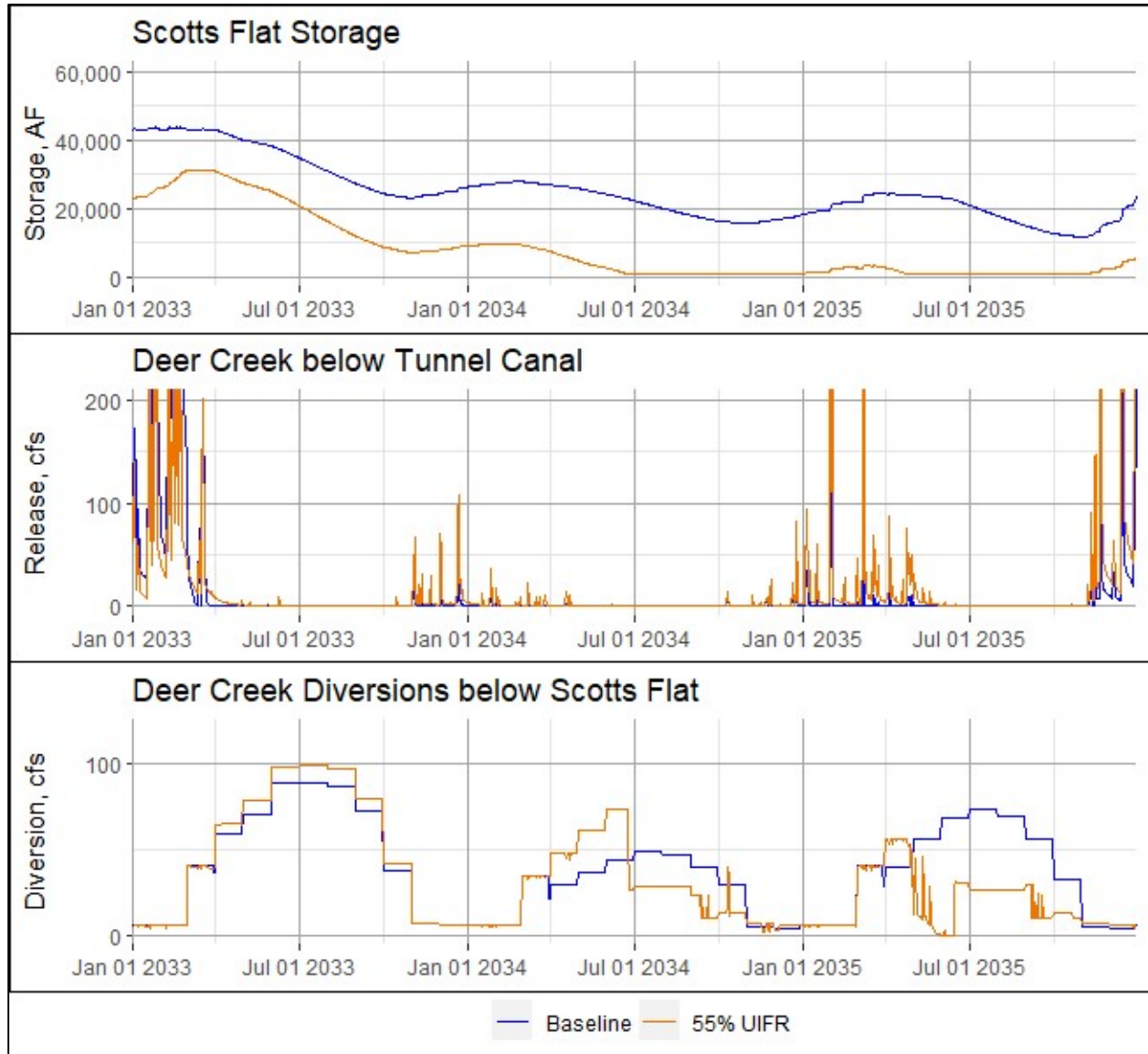


Figure 39 shows operations at Scotts Flat Reservoir. Scotts Flat Reservoir is highly dependent on imports from the Yuba River. The reduction of these imports resulting from loss of supply at upstream reservoirs results in the Reservoir going empty in most dry years which then reduced the ability for the reservoir to make deliveries downstream.

Figure 39 - Scotts Flat Reservoir Operations, Wet Climate 2033-2035



## Operations Examples – Three-Year Drought Sequence – Historic Climate

Below is a series of plots showing the modeled project operations during a three-year drought sequence with historic inflows, both with and without the unimpaired flow requirements. Figure 40 shows operations at Jackson Meadows Reservoir. Compared to the existing condition, the 55% unimpaired flow requirement causes more releases earlier in the season, resulting in lower storage levels at the end of the fill season and less releases for diversion into the system in the summer.

Figure 40 - Jackson Meadows Reservoir Operations, 1990-1992

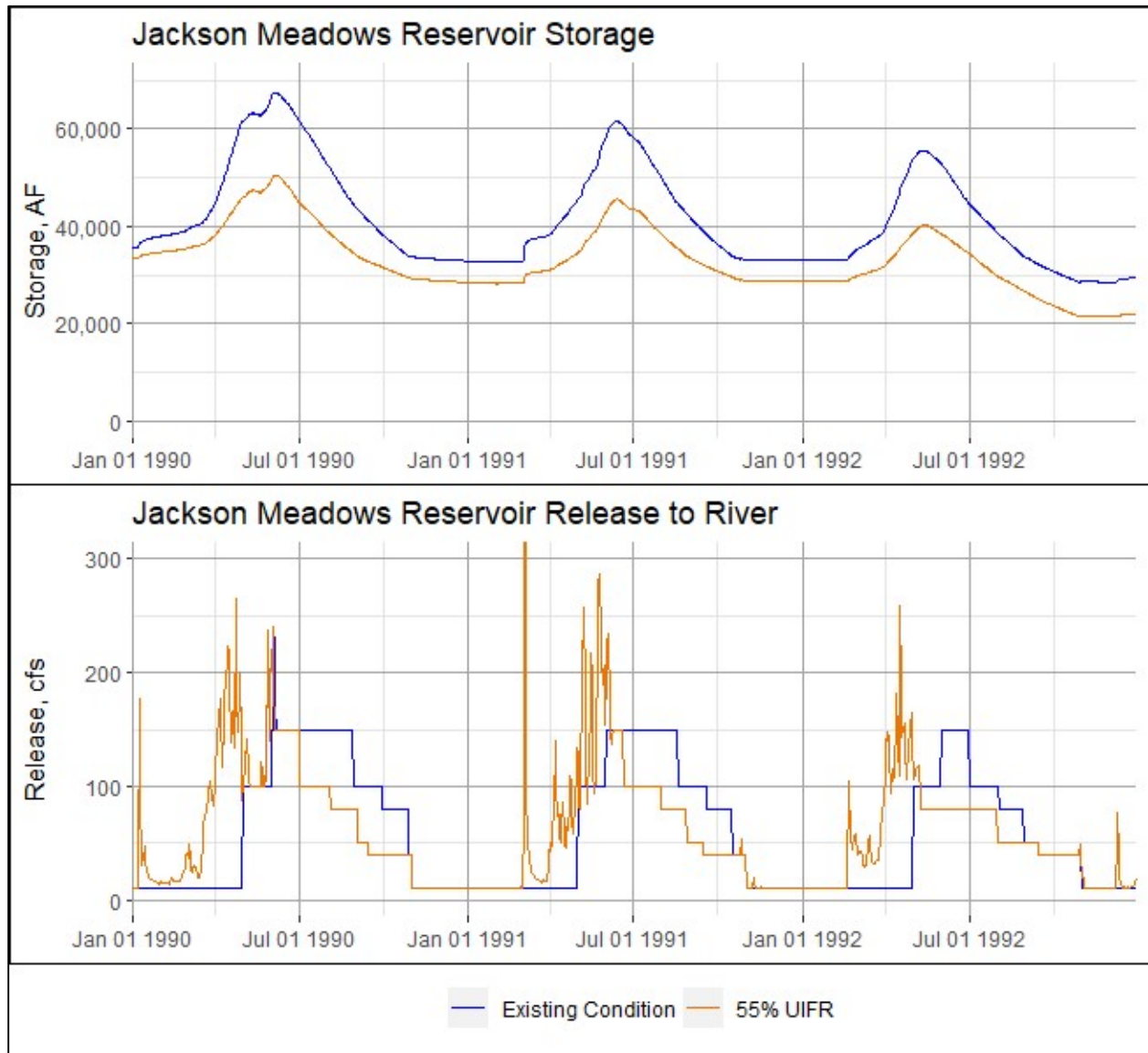


Figure 41 shows operations at French Lake. The releases in the winter and spring cause lower fill levels and reduced ability to release water for downstream diversion during the summer.

Figure 41 - French Lake Operations, 1990-1992

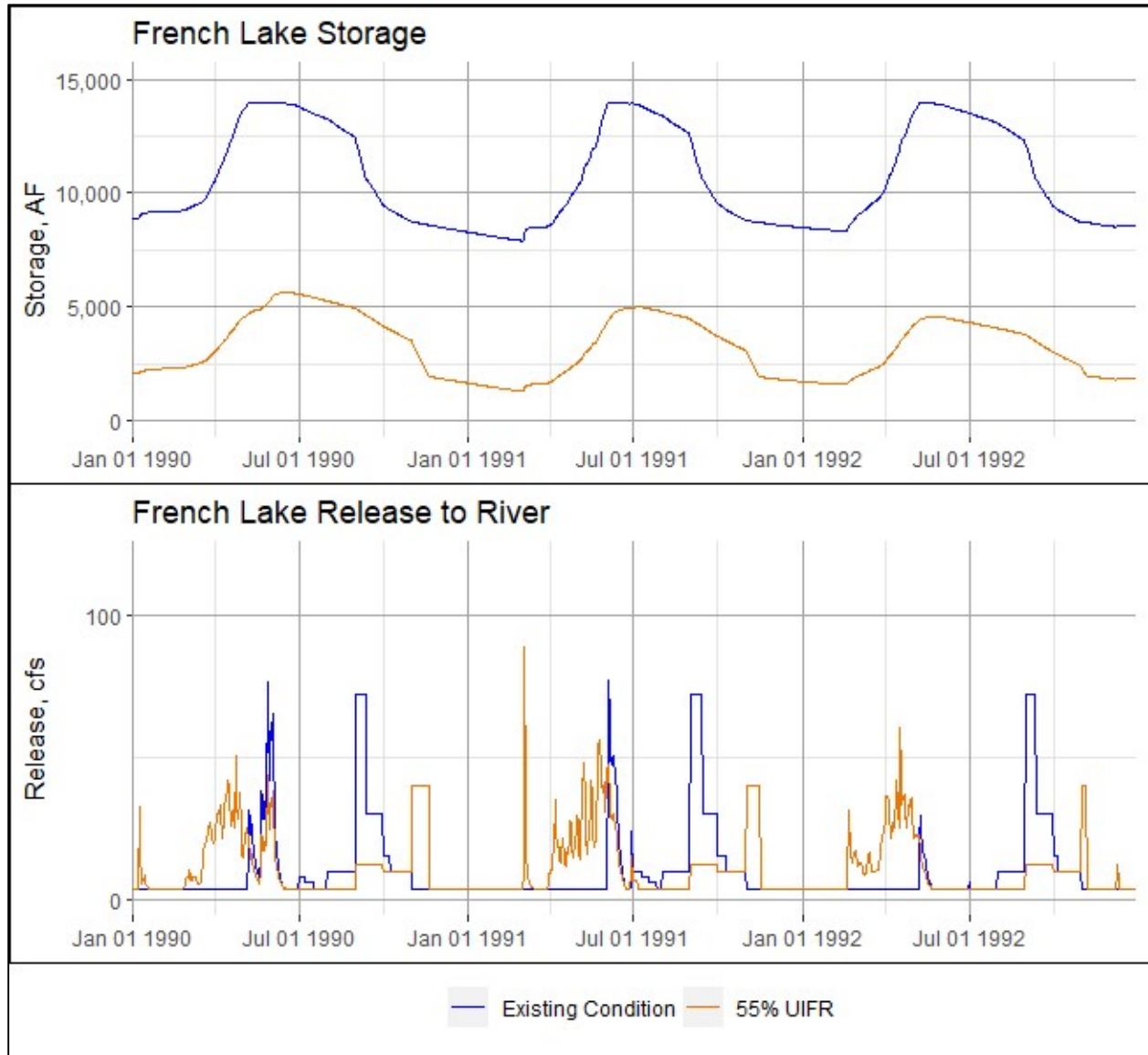


Figure 42 shows operations at Bowman Lake. Bowman Lake storage is highly affected by the combination of increased releases in the winter and spring due to the 55% unimpaired flow requirements and less imports from the Middle Yuba from Jackson Meadows Reservoir. This lower fill level results in less water available for diversions into the NID system.

Figure 42 - Bowman Lake Operations, 1990-1992

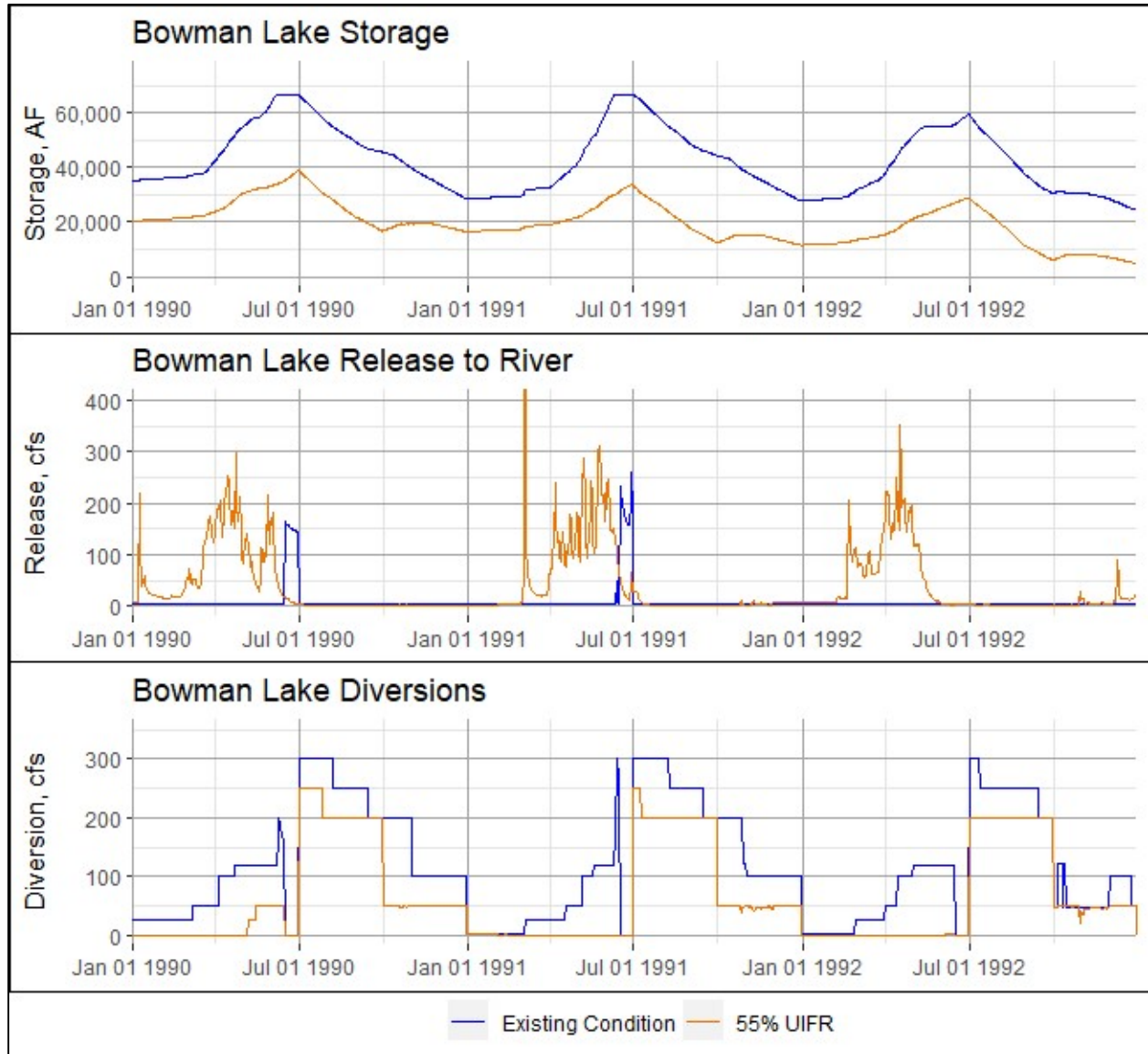


Figure 43 shows operations at Rollins Reservoir. With 55% unimpaired flow requirements and reduced imports from the Yuba River, Rollins does not necessarily fill in Dry Years. This results in less ability to make diversions into the Bear River Canal and less ability to move water down to Lake Combie to maintain Lake Combie reservoir elevations.

*Figure 43 - Rollins Reservoir Operations, 1990-1992*

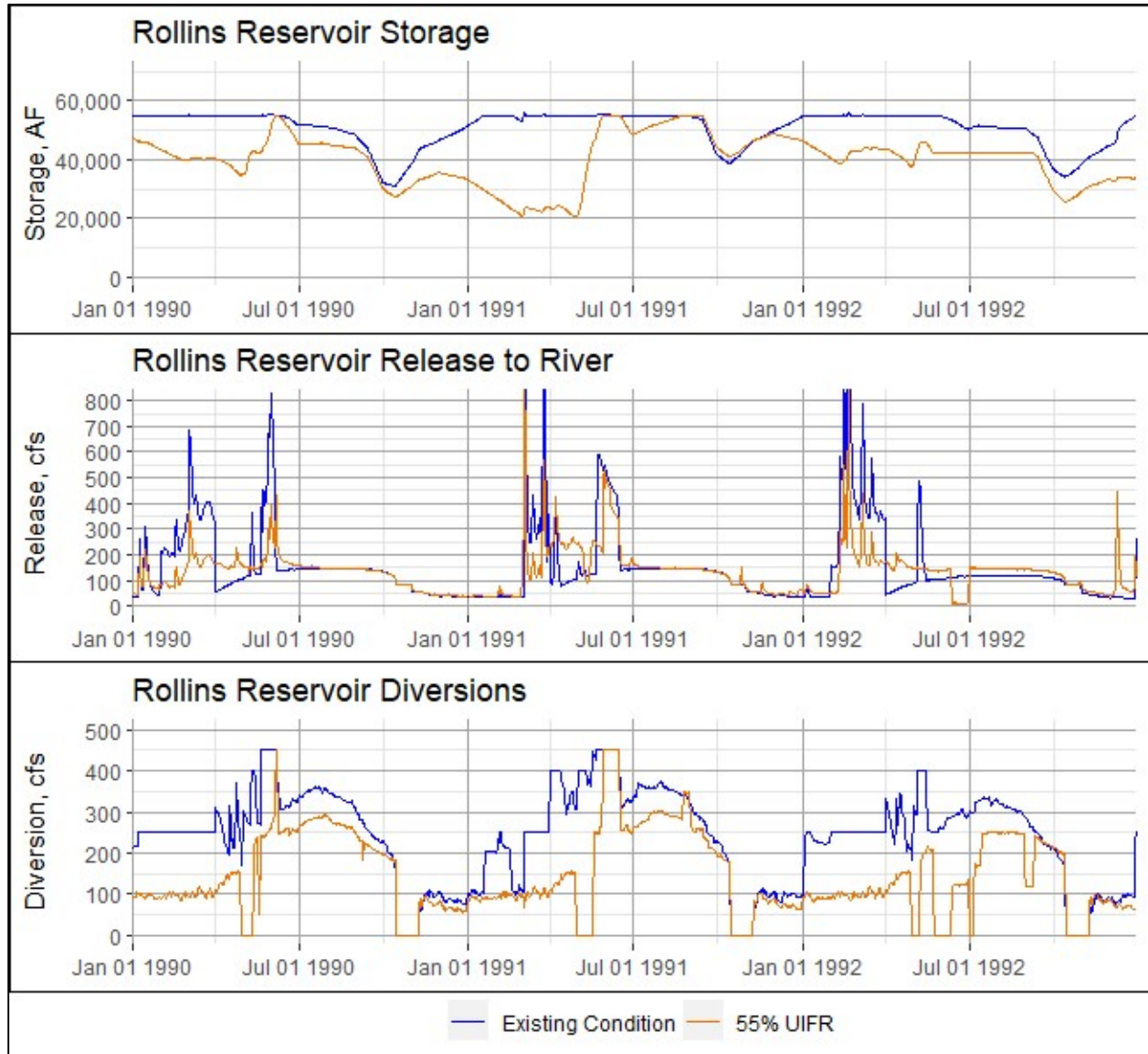


Figure 44 shows operations at Lake Combie. With reduced imports into the Bear River and 55% unimpaired flow requirements Lake Combie cannot maintain a full pool and may not fill in dry years.

Figure 44 - Lake Combie Operations, 1990-1992

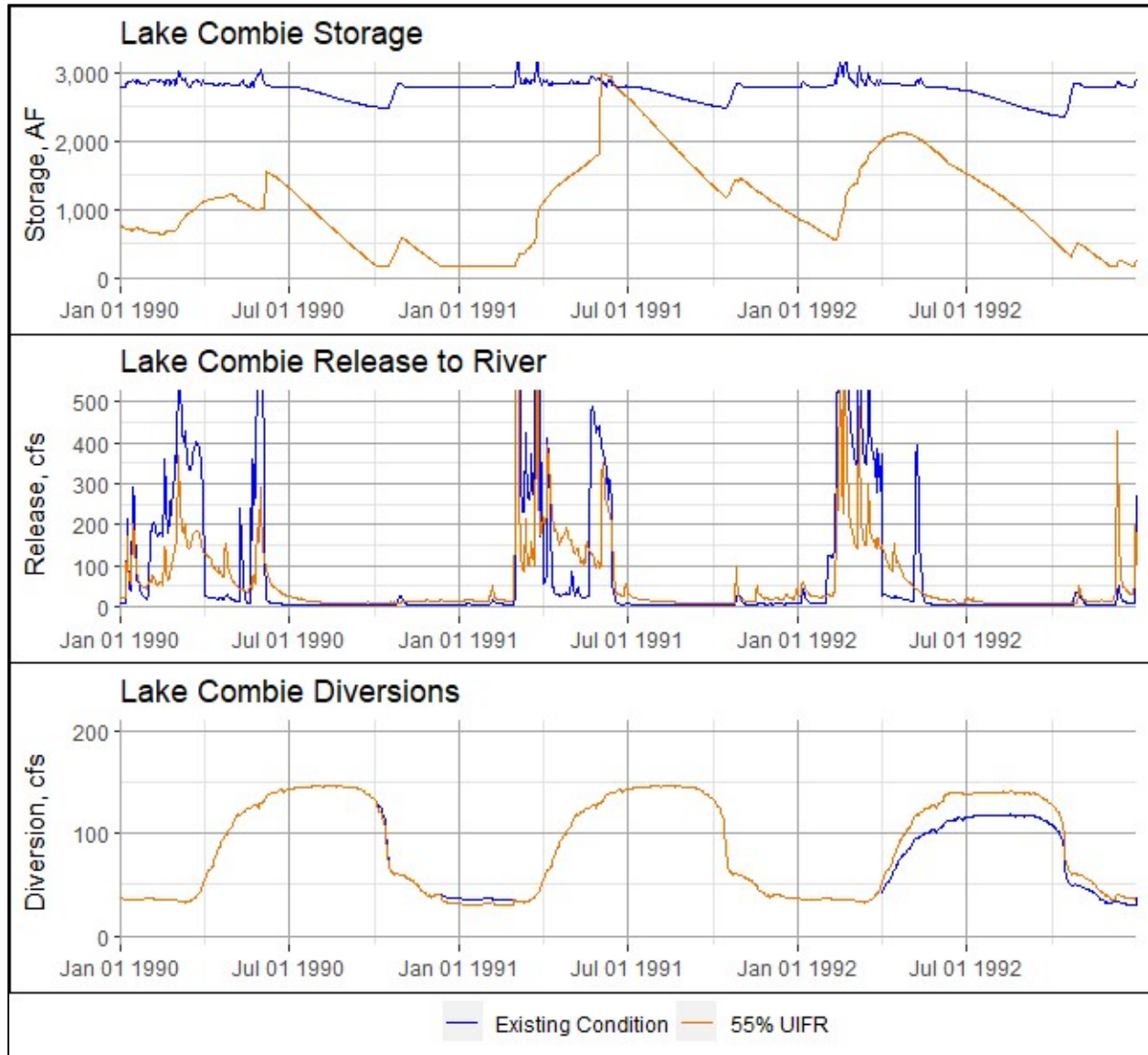


Figure 45 shows operations at Scotts Flat Reservoir. Scotts Flat Reservoir is highly dependent on imports from the Yuba River. The reduction of these imports resulting from loss of supply at upstream reservoirs results in the Reservoir going empty in most dry years which then reduced the ability for the reservoir to make deliveries downstream.

Figure 45 - Scotts Flat Reservoir Operations, 1990-1992

